Dec. 31, 1929. L. R. HEIM 1,741,236

GRINDING

Filed April 26, 1922 3 Sheets-Sheet 1

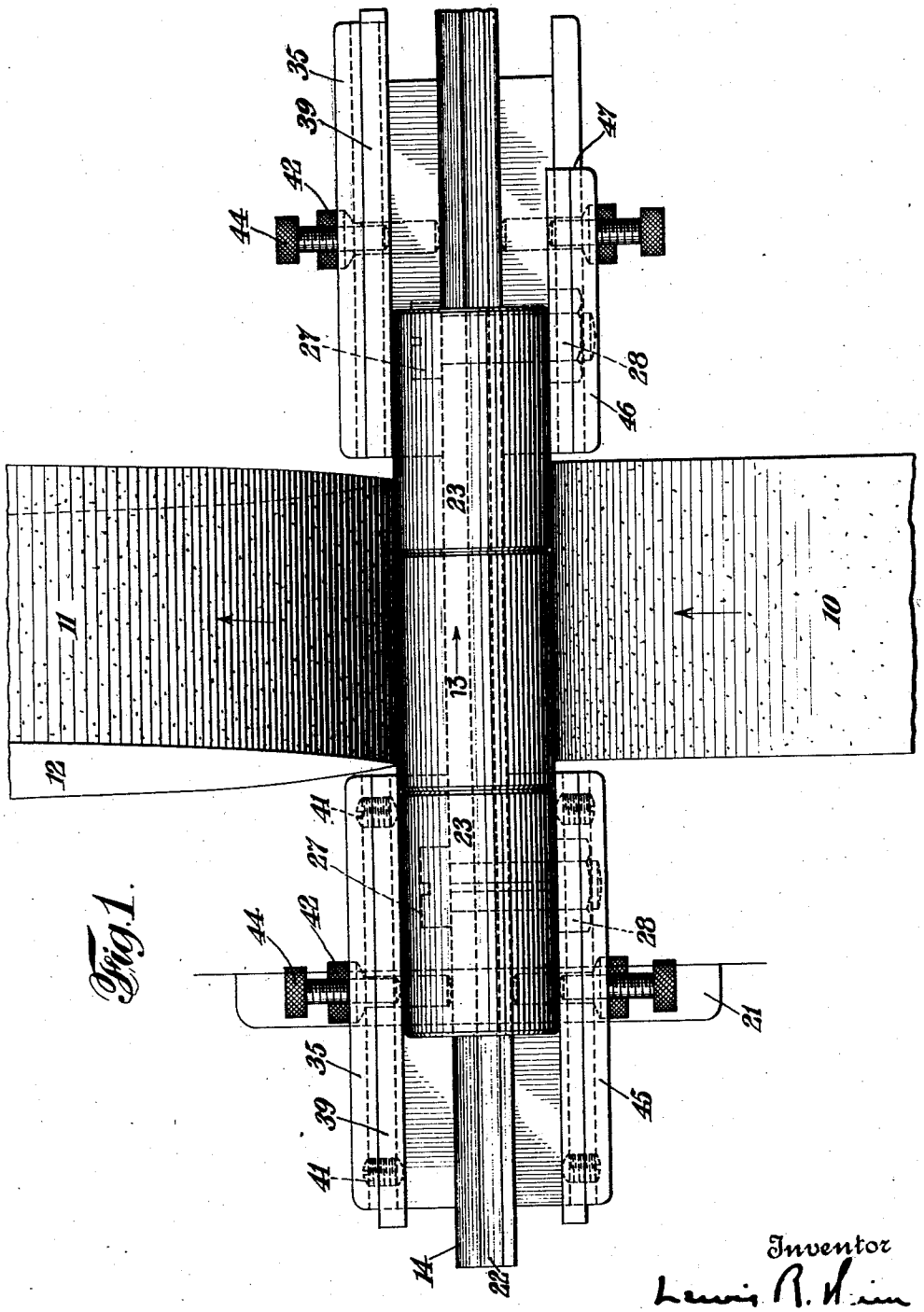


Fig. 1.

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GRINDING

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Fig. 2.

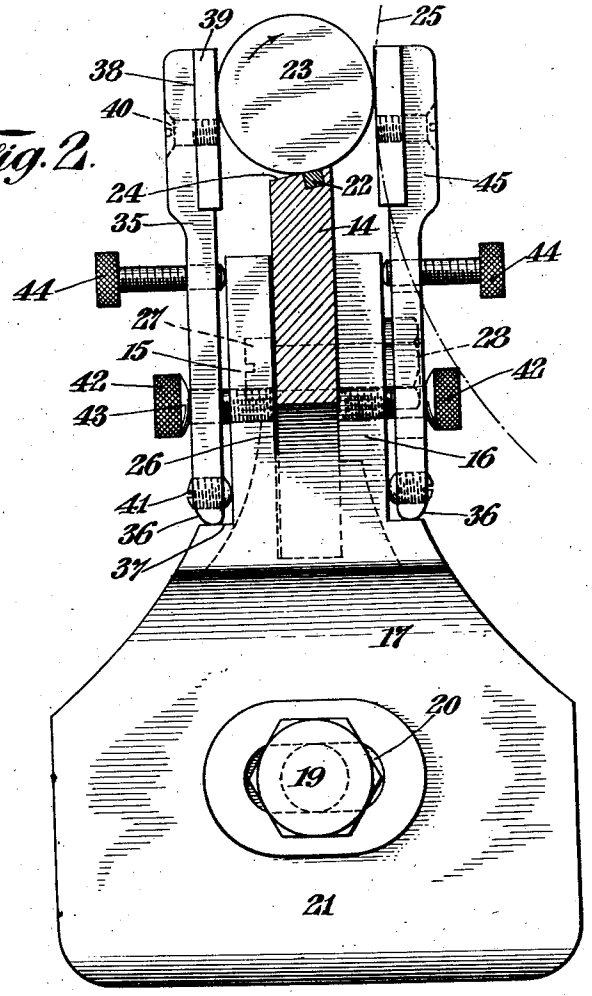


Fig. 4.

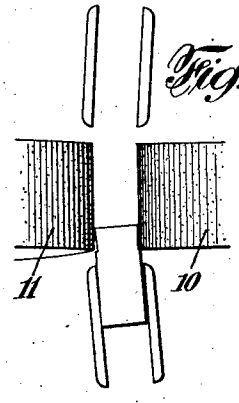


Fig. 5.

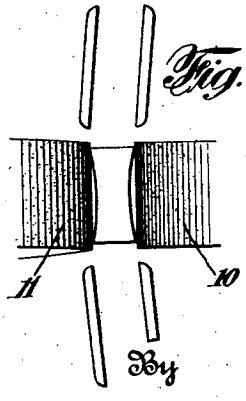
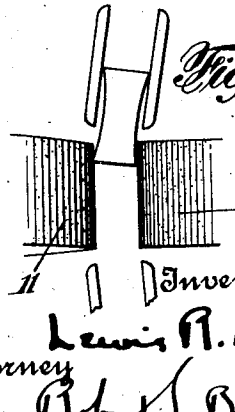


Fig. 6.



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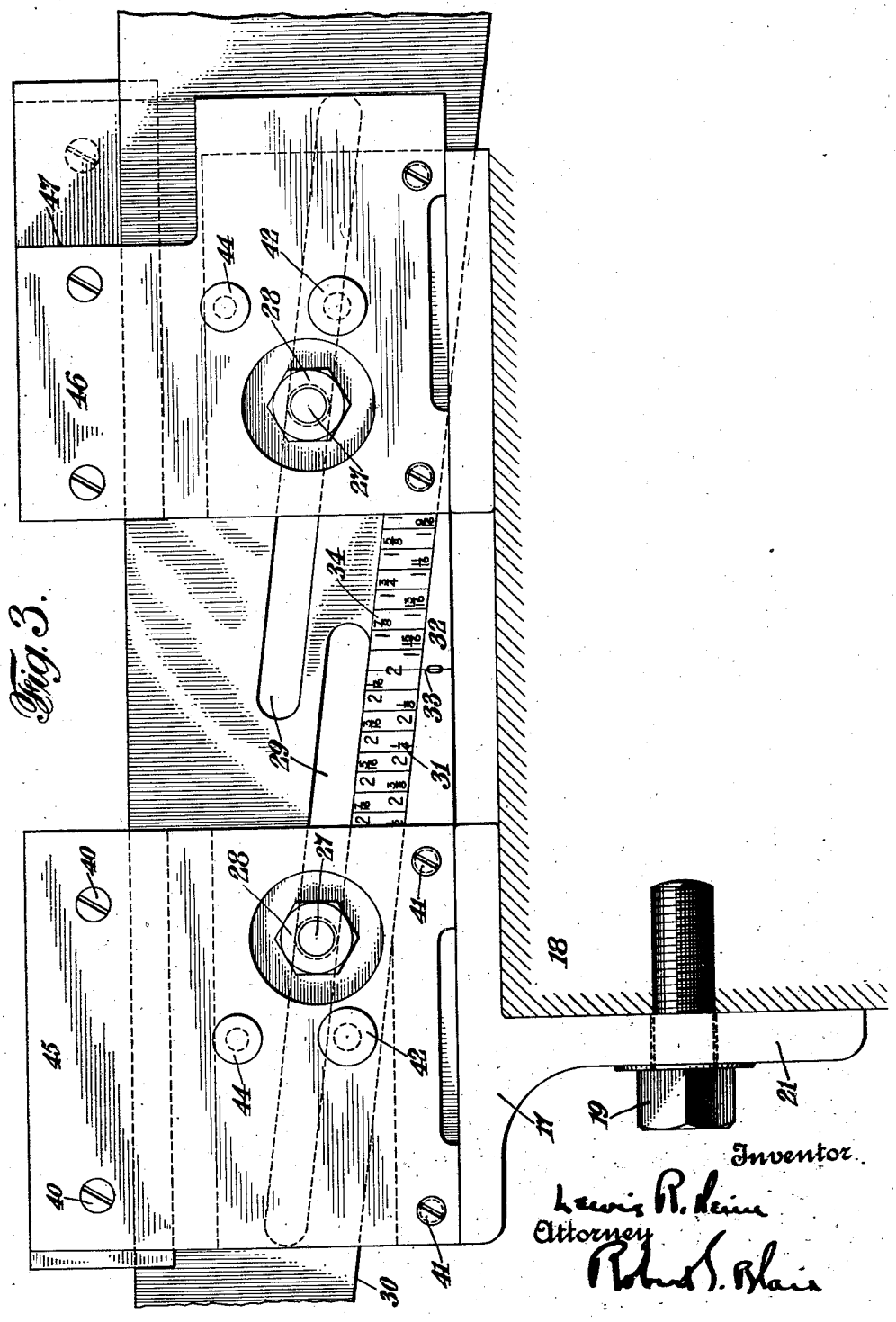


Fig. 3.

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UNITED STATES PATENT OFFICE

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GRINDING

Application filed April 26, 1922. Serial No. 556,635.

This invention relates to grinding and more particularly to centerless grinding.

One of the objects thereof is to provide practical grinding apparatus which shall be readily adaptable to meet changing conditions of use.

Another object is to provide grinding apparatus in which the action is rapid and accurate and the construction compact and simple.

Another object is to provide dependable apparatus of the above nature adapted to permit variation of the shape of the resultant product and yet maintain accurate grinding action.

Another object is to provide a simple and practical art of grinding by which the effect of the grinding action is under exact control.

Another object is to provide an art of the above nature by which the shape of an accurately ground article may be varied and yet exact circular cross-section maintained.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, arrangement of parts, and in the steps and combinations of steps, all as will be illustratively hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which is shown one of various possible embodiments of the mechanical features of this invention:

Fig. 1 is a plan of the same;

Fig. 2 is an end elevation partially broken away;

Fig. 3 is a side elevation also partially broken away;

Fig. 4 is a diagrammatic plan illustrating one stage of a grinding action;

Fig. 5 is a similar view illustrating a later stage;

Fig. 6 is a similar view illustrating a still later stage.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Considering first the construction of the apparatus features of this invention, there is shown in Fig. 1 of the drawings a grinding wheel 10 and a regulating wheel 11. These wheels are formed to provide suitable abrasive surfaces and are preferably of the hard form, such as emery wheels. The driving mechanism for these wheels forms in itself no part of the present invention, but it may be noted that the grinding wheel is driven at a high speed to give a rate of travel of its peripheral surface best suited for grinding action. This surface in the embodiment shown travels leftward in plan as indicated by the arrow and downwardly at its operative surface where it engages the work. The regulating wheel is rotated in an opposite direction, by which it is, of course, meant that its operative or active surface travels substantially opposite the corresponding portion of the grinding wheel. The chief functions of the regulating wheel are to rotate and feed the work, and it may be noted that it is driven at a far lower speed than the grinding wheel and preferably does not slip to any substantial extent with respect to the work which it contacts. It is set at a slight angle with respect to the axis of the work, as is indicated by its exposed surface 12, and thus gives a component of its action on the work in the direction indicated by the arrow 13, which feeds the rolls lengthwise along their support hereinafter described. This angle may be, if desired, varied to correspondingly vary the rate of feed of the work at a given rate of drive of the wheels.

Positioned between the wheels 10 and 11 is a carrier or work-support 14 shown in end elevation in Fig. 2 of the drawings. The work-support 14 is a flat piece of steel inserted between the pairs of flanges or webs 15 and 16 of a fixture or supporting member 17, which is bolted to the machine frame 18 by means of a screw 19 passing through a slot 20. The latter slot is formed in the front plate 21 of the fixture or supporting member 17 which rests against the front of the machine frame and being elongated thus permits the fixture or supporting member with its associated parts to be adjusted to the right or left, having reference to Fig. 2 of

the drawings, and locked in adjusted position.

As the parts at both the forward and rear side of the wheels are substantially identical, except as hereinafter noted, those on the forward side only, shown in full in Fig. 2, will be described in detail.

The work-support 14 is provided with an upper surface which is inclined downwardly toward the regulating wheel, as shown in Fig. 2 of the drawings. In this surface there is formed a recess, here shown as square, in which is fitted a wear-strip 22 on which the work rests. This wear-strip of hardened steel is adapted to support the work, and upon its surface becoming worn it is readily removable and reinserted after turning it 90° to substitute an unworn surface. The work 23 is here shown as a succession of cylindrical rolls resting upon the member 22 and guided as hereinafter described into a position between the wheels. When it passes within the grip of the wheels, it is continuously rotated in the direction of the curved arrow in Fig. 2 of the drawings and is thus evenly and accurately ground by the grinding wheel and meanwhile fed along the surface and out from between the wheels by the thrust of the regulating wheel hereinbefore described.

The inclined upper surface of the work-support results in the work being urged by gravity against the regulating wheel and thus evenly maintained in operative relation thereto. Furthermore, if there be a slight irregularity in its surface, such as an outward projection, the latter upon engaging the regulating wheel will force the work not directly toward the grinding wheel but upward along the inclined surface 24 as well as rightward with respect to Fig. 2. This prevents the grinding wheel from cutting into the opposite surface of the work every time such irregularity engages the regulating wheel, for the lifting by the surface 24 brings the work opposite a more distant portion of the grinding wheel due to its curvature, as indicated at 25 in Fig. 2. Thus, the work as it passes between the wheels, even though it originally has irregularities in its surface, is quickly perfected as it is rotated about its axis by the regulating wheel and cut into true shape by the grinding wheel, and it will be seen that the action is self-correcting due to the action of the inclined surface 24 of the work-support.

Turning now to the method of mounting the work-support 14 on the fixture 17, it is preferably given a loose fit between the flanges 15 and 16 both at the forward and rear portion of the machine, as is indicated by the space 26. It is held snugly against the flange 16 by means of bolts 27 provided with nuts 28.

As shown in Fig. 3 of the drawings, the work-support member 14 is provided with a pair of inclined slots 29 through which the bolts 27 at the forward and rear end pass. Although the upper surface of the work-support is substantially horizontal, its lower surface is inclined as indicated at 30 and rests against a similarly inclined surface 31 cut in the fixture or supporting member 17. Thus, if the work-support 14 were moved lengthwise, its upper surface would rise or fall according to its movement toward the front or toward the rear of the machine, it being understood that the front of the machine is the left-hand portion with respect to Fig. 3 of the drawings.

Between the wheels the flange or web 16 is much reduced in height, as shown at 32, and is provided with a zero mark 33 coacting with graduations 34 formed on the lower side of the work-support 14. These graduations indicate the diameter of the work which the work-support is set to grind. That is, if the work-support be slid to the right, having reference to Fig. 3, its upper surface will fall, thus permitting work of a larger diameter to be placed thereon and yet contact at the proper lines on the grinding and regulating wheels. Conversely, if it be slid to the left, its upper surface will rise, moving it into position for grinding smaller work, all as illustratively indicated by the graduations. It is to be understood that when the elevation of this work-support 14 is to be adjusted, the nuts 28 are loosened, and after the work-support 14 has been slid into its desired position, these nuts are tightened. Thereupon the work-support will be dependably held in precisely its desired adjustment.

Considering now the guiding parts shown at the forward side of the machine, understanding as hereinbefore pointed out that those at the rear are substantially identical, it is to be noted that both of these guides 35 and 45 are adjustably mounted upon the flanges or webs 15 and 16, as shown in Fig. 2. The guide 35 is rounded at its lower end 36 to rock upon a shoulder 37 formed on fixture 17. The upper end of the guide is recessed as at 38 to receive a rectangular wear-strip 39 of hardened steel, which is secured in position as by the screws 40. These wear-strips upon having their surface worn are readily removable and reversible to turn their inner side outwardly and thus give a fresh surface for wear. Furthermore, as the screws 40 are at the center of the wear-strip in an up-and-down direction, the latter may be removed and inverted, thus giving two additional surfaces for wear. In this manner, however severely the machine may be used, it will stand up for a considerable period without the necessity for replacing parts.

The guide 35 is provided at its lower end with a pair of round-nosed gib screws 41 which determine its position with respect to

the adjacent flange 15. If the guide is to be set parallel to the work-support 14, the rounded inner ends of the screws will project equal distances from the inner surface of the guide. However, as hereinafter described, the guides may be set at inclination with respect to the work-support, and this setting is rendered secure at the bottom by a suitable adjustment of these screws. In other words, they form the fulcrum about which the guides may rock or swing in any desired plane.

The above swinging movement is gained from each guide by a single adjusting screw 42 provided with a narrowed head and having the inner surface of the head rounded or tapered as at 43 to permit the guide to rock with respect thereto. This screw 42 is threaded into the flange or web 15 and may be set at any desired point to determine the outward swing of the guide. The above adjustment having been determined, the locking screw 44 positioned directly above the screw 42 is tightened, and thus locks the entire guide plate in its desired position.

The screw 42, it will be seen, tends to move the guide 35 inwardly toward the flange 15 of the supporting member or fixture 17, and hence toward the work-support 14. The screw 44 above the screw 42, bearing against the surface of the flange 15, tends to move the guide 35 outwardly away from the flange 15 and from the work-support 14. By means of the screw 42 the guide 35 is swung inwardly about its pivotally supported lower portion 36, and by means of the screw 44 the guide 35 is swung outwardly about its lower portion 36. The screws 41 below the screw 42, as well as the screw 44 above the same, tend to move the guide 35 outwardly away from the flange 15. By means of these screws 41, the pivotally supported lower end 36 of the guide may be adjusted toward or away from the flange 15. Also by threading one of the screws 41 in and the other out, the guide 35 is swung about a vertical axis extending through the two screws 42 and 43 and may be securely locked in the position to which it is swung. The guide 35 may thus be swung about a vertical axis and may also be swung about a horizontal axis through its lower portion 36.

It will be understood that similar construction and adjustment is employed with respect to the opposite guide 45 and also with respect to the two guides at the rear of the machine, as hereinbefore explained.

To the latter there is a slight exception in the preferred construction of the rear guide 46, which, as shown in Fig. 3 of the drawings, is cut away, as at 47, to permit the finished work to be removed laterally from the work-support, if desired.

The action of the above apparatus will, it is believed, in large part be understood from the foregoing.

The parts are first set to grind the desired diameter of work. First the height of the carrier or work-support 14 is adjusted, as hereinbefore described, to bring the work up to the correct level. The carrier or work-support, furthermore, is adjusted to its proper position between the grinding and regulating wheels by adjusting the position of the fixture or supporting member 17 by means of the screw 19. The guides are thereupon suitably adjusted, and, assuming that the work is to be cylindrically ground, they are brought parallel with the workrest by means of the screws 41 and each guide adjusted toward or away from the workrest to the desired extent and locked in position by the screws 44. In this action, it is to be understood that the guides not only may be rocked toward or away from the workrest, but may, if desired, be moved bodily by a suitable adjustment of the various screws. The several guides thus positioned, the work is fed on to the work-support between the forward guides and into the grip of the wheels. It is necessary to describe in further detail the action of the wheels, but it may be noted that the rolls are accurately ground and fed out between the receiving guides in the rear of the machine, from which they may be removed either by being discharged lengthwise or taken off laterally through the gap 47. The action on the rolls is not only self-correcting during the grinding due to the inclined surface of the carrier, but due to this inclination the rolls press evenly toward the regulating wheel and against the left-hand guides, having reference to Fig. 2 of the drawings.

If desired, the guides may be so positioned as to grind the work to other than a cylindrical form. Such action to give a concave work is illustrated in Figs. 2 to 4 of the drawings. In these figures, the wheels 10 and 11 are at the usual position, but the entering or forward guides fit the work loosely and are inclined rearwardly to the left in plan, whereas the discharging or rear guides have an opposite inclination. Thus, as the roll enters the grip of the wheels, as shown in Fig. 4, it being understood that the inclinations are much exaggerated in these figures, the forward end of the roll is only slightly ground, but the depth of cut of the grinding wheel is rapidly increased as the roll progresses into the grip. That is, as it makes the turn from its direction in the forward guides to its direction when entirely between the wheels, its central portion is cut away to a depth which progressively increases until the center of the roll is reached and thereafter progressively decreases. This action furthemore is repeated as the roll passes out of the grip into the rear guides, as shown in Fig. 6 of the draw-

ings. The degree of convexity, the other things being equal, is determined by the inclination of the guides with respect to the work rest and any desired result may be obtained.

It will be obvious that by an inclination of the guides in the reverse direction, that is, with the forward guides adjusted to extend rearwardly and to the right in plan, precisely the opposite effect will be obtained and the rolls will be ground into convex form. Furthermore, this convexity may be varied by varying the inclination of the guides in a manner similar to that above described with respect to the arrangement of Figs. 4, 5 and 6.

It will thus be seen that there is provided apparatus by which the various mechanical objects of this invention may be achieved. This apparatus is rigid in so far as its structure is concerned and yet is given such a wide latitude of adjustability as to adapt it to meet all conditions of use and give a wide variety in the desired results without departing from an accurate adherence to the predetermined form of the work.

It will also be seen that there is set forth an art which may be quickly and conveniently carried on and by which the corresponding objects of this invention may be achieved.

As various changes might be made in the construction hereinabove set forth and as the art herein described might be varied, all without departing from the scope of this invention, it is to be understood that all the matter herein described as shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In grinding apparatus, in combination, a work support, a guide, means supporting said guide adjacent the lower edge thereof and mounting said guide to swing about a substantially horizontal axis toward and away from said work-support, and means adapted to lock said guide in the position into which it is swung.

2. In grinding apparatus, in combination, a supporting member, a work-support mounted thereon, a guide mounted upon said supporting means adjacent said work-support, means independent of said work-support tending to swing said guide toward said supporting member, and means interposed between said guide and said supporting member tending to swing said guide away from said work-support.

3. In grinding apparatus, in combination, a work-support, a guide mounted adjacent thereto to swing about a substantially horizontal axis adjacent its lower portion, means adapted to adjust the position of said lower portion in a direction away from said work-support, and means adapted to lock said guide in the position into which it is swung.

4. In grinding apparatus, in combination, a supporting member, a guide mounted adjacent said supporting member, a device tending to move said guide with respect to said supporting member, and a pair of devices positioned respectively above and below said first device and both tending to move said guide with respect to said supporting member in a direction opposite to that in which said first device tends to move said guide.

5. In grinding apparatus, in combination, a supporting member, a guide, a pair of threaded devices coacting with said guide, one of which devices is upwardly spaced from the other upon said guide and each of which devices tends to move said guide away from said supporting member, and a threaded device intermediate said first two devices tending to move said guide toward said supporting member.

6. In grinding apparatus, in combination, supporting means, a guide having its lower portion adapted to rock on said supporting means, means adjacent the lower edge of said guide adapted to adjust laterally said lower edge with respect to said supporting means, and means interposed between said supporting means and said guide at a higher portion of said guide and adapted to hold said guide in the position into which it is rocked.

7. In grinding apparatus, in combination, supporting means, a guide mounted upon said supporting means, a pair of devices independently adjustable to swing said guide relative to said supporting means about a substantially upright axis, and means adapted to lock said guide in the position into which it is swung.

8. In grinding apparatus, in combination, a work-support, a guide adapted to coact with work upon said support, means adapted to swing the said guide about a substantially upright axis relative to said work-support, means adapted to swing the said guide about a substantially horizontal axis relative to said work-support, and means adapted to lock said guide in the position into which it is swung.

9. In grinding apparatus, in combination, work-supporting means provided with a laterally inclined upper surface, a guide toward which work on said support tends to roll, and means adapted to adjust the position of said guide toward and away from said work-support and lock it in adjusted position.

10. In grinding apparatus, in combination, a grinding wheel, a regulating wheel, means adapted to guide work into the grip of said wheels, and means acting upon said guiding means at two points thereof adapted to vary the inclination of said guiding means about a substantially upright axis.

11. In grinding apparatus, in combination, a grinding wheel, a regulating wheel, guiding means adapted to guide work into the grip of said wheels, guiding means adapted to receive the work as it passes from the grip of said wheels, and means adapted independently to vary the angular positions of each of said guiding means about substantially upright axes.

12. In grinding apparatus, in combination, a grinding wheel, a regulating wheel, a work-support positioned to tend to urge the work by gravity toward said regulating wheel, a guide against which said work tends to move by gravity, and means adapted to vary the position of said guide about a substantially upright axis.

13. In grinding apparatus, in combination, a grinding wheel, a regulating wheel, a work-support, a pair of substantially parallel guides on opposite sides of said work-support adapted to direct work thereon into the grip of said wheels, and means adapted to alter the position of said guides angularly with respect to an upright plane through the axis of said grinding wheel and maintain their inner surfaces in substantial registry with the opposite portions of said grinding and regulating wheels.

14. The herein-described art of grinding which consists in forcing work as it travels out of the grip of coacting grinding and regulating wheels into a path laterally inclined with respect to the direction which it occupied while positioned midway in its travel between said wheels.

15. The herein-described art of grinding which consists in inserting work into the grip of coacting grinding and regulating wheels in a position in which it lies substantially within the plane of the axes of said wheels and is inclined with respect to a plane tangent to the operating surface of said grinding wheel and perpendicular to said first plane.

16. In a grinding machine, in combination, a grinding throat including a grinding wheel and a regulating wheel, a work-supporting member adapted to receive work passing from said grinding throat, a pair of guiding members mounted adjacent said work-supporting member and positioned to engage and guide the work as it passes from said grinding throat, one of said guides being shaped to provide an opening for lateral passage of the work from said work-supporting member after the work is fully removed from the grinding throat.

17. In a grinding machine, in combination, a grinding throat including a grinding wheel and a regulating wheel, means exterior of said grinding throat for guiding work axially with respect to said grinding throat comprising a supporting member, a pair of guides one on each side of said work-supporting member, said guides being mounted for swinging movement about axes substantially parallel to the path of movement of the work to adjust said guides in a direction toward and away from each other, and means for swinging said guides.

18. In a grinding machine, in combination, a grinding throat including a grinding wheel and a regulating wheel, means exterior of said grinding throat for guiding work axially with respect to said grinding throat comprising a work-supporting member, a pair of guides mounted on opposite sides of said work-supporting member, said guides being mounted for swinging movement about axes substantially parallel to the path of travel of the work for adjustment of said guides independently toward and away from each other, and means adapted to lock said guides in the position into which they are swung.

19. In a grinding machine, in combination, a grinding throat comprising a grinding wheel and a regulating wheel, means exterior of said grinding throat for guiding work axially with respect to said grinding throat comprising a work-supporting member, a guide mounted adjacent thereto adapted to guide the work along said work-supporting member, means mounting said guide adapted to permit adjustment thereof angularly about an axis substantially at right angles to the path of movement of the work, and means for moving said guide bodily toward and away from work-supporting member without altering its angular adjustment about said axis.

20. In a grinding machine, in combination, a grinding throat comprising a grinding wheel and a regulating wheel, means exterior of said grinding throat for guiding work axially with respect to said grinding throat comprising a work-supporting member, a pair of guides mounted on opposite sides of said work-supporting member, and means adapted to swing both of said guides with respect to said work-supporting member about axes substantially at right angles to the path of movement of the work and adapted to lock said guides in the position into which they are swung.

21. In a grinding machine, in combination, a grinding throat including a grinding wheel and a regulating wheel, means for supporting and guiding work axially with respect to said grinding throat comprising a work-supporting member provided with an inclined surface, supporting means provided with an inclined surface coacting with said inclined surface on said work-supporting member, said coacting inclined surfaces being adapted to move said work-supporting member transversely with respect to said grinding throat when said work-supporting member is moved lengthwise, means for moving said work-supporting member lengthwise,

and means for locking said work-supporting member relative to said supporting means in the position into which it is moved.

22. The herein described art of grinding which consists in forcing work into the grip of coacting grinding and regulating wheels in a path laterally inclined with respect to the direction which it occupies and follows while positioned midway in its travel between said wheels.

In testimony whereof, I have signed my name to this specification this nineteenth day of April, 1922.

LEWIS R. HEIM.