May 25, 1926. 1,585,984

L. R. HEIM

GRINDING

Filed August 29, 1922 2 Sheets-Sheet 1

Fig. 1.

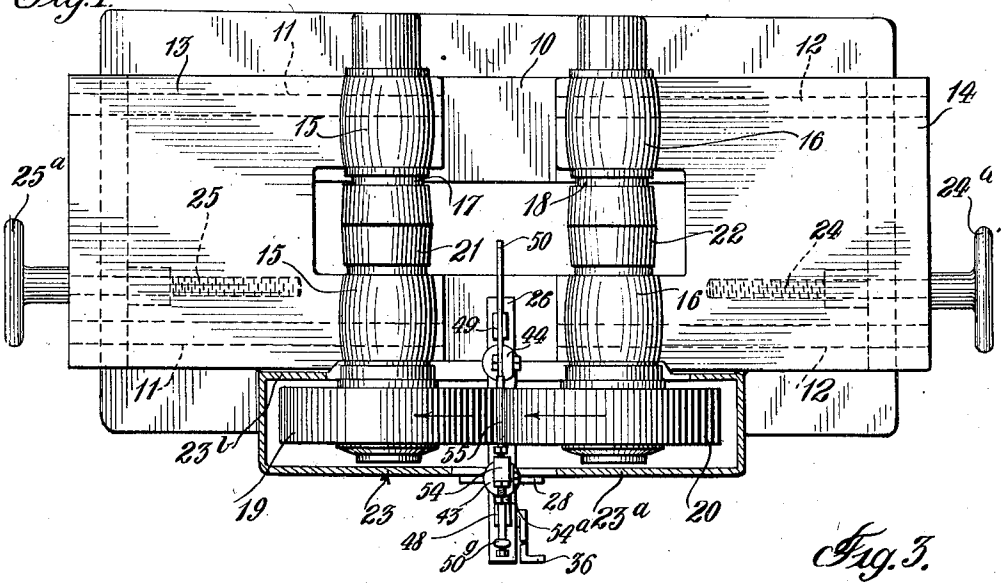


Fig. 3.

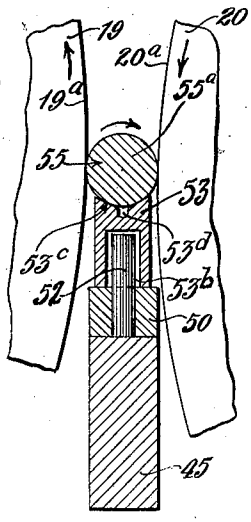
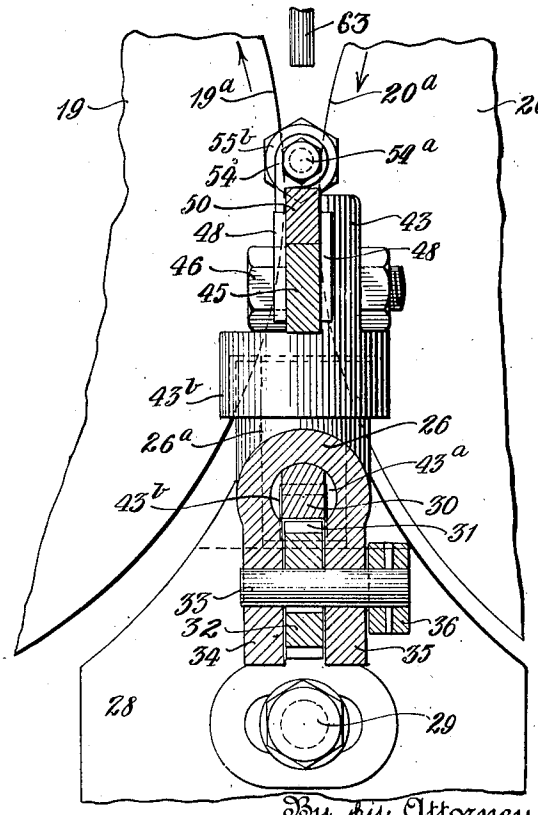


Fig. 2.



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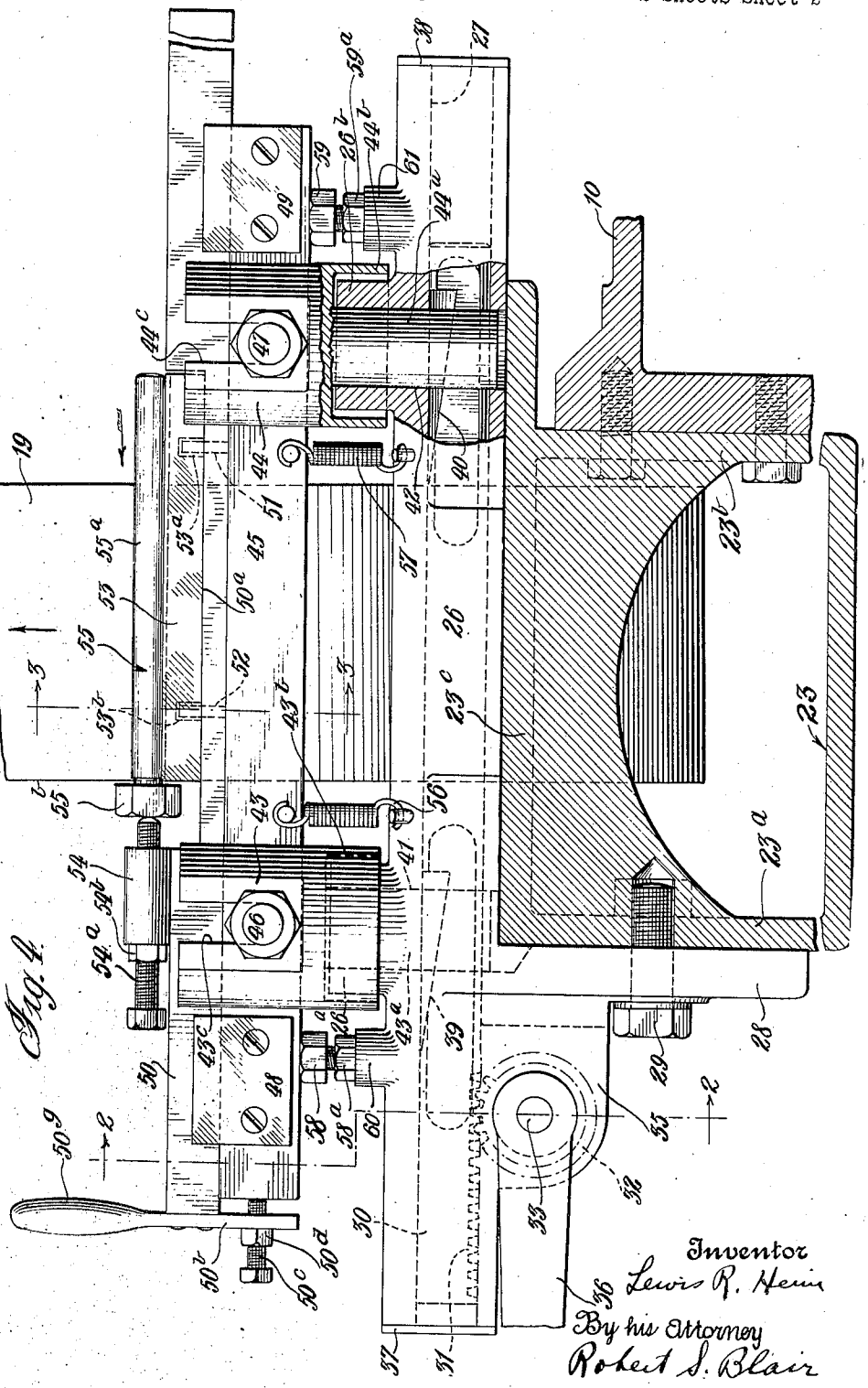


Fig. 4.

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Patented May 25, 1926. 1,585,984

UNITED STATES PATENT OFFICE.

LEWIS R. HEIM, OF DANBURY, CONNECTICUT, ASSIGNOR TO THE HEIM GRINDER COMPANY, OF DANBURY, CONNECTICUT, A CORPORATION OF CONNECTICUT.

GRINDING.

Application filed August 29, 1922. Serial No. 584,955.

This invention relates to grinding and, more particularly, to an apparatus for grinding articles or bodies of irregular shape.

One of the objects of this invention is to provide a practical and simple apparatus for grinding articles or bodies and more particularly for grinding bodies of irregular shape, a portion of each of which is substantially cylindrical and another portion of each being of greater radial extent than the cylindrical portion; and to provide apparatus of the above nature of efficient, dependable and accurate action.

Another object of this invention is to provide apparatus of the above nature capable of convenient and rapid manipulation by the operator without the requirement of a high degree of skill and capable also of ready adjustment to meet with varying requirements of practical use. This invention aims also to provide apparatus of the above type of rugged and durable construction and of positive action thereby to insure uniformity of result. This invention aims also to provide a simple and practical art for grinding articles or bodies of irregular shape which may be inexpensively and rapidly carried on with the attainment of accurate, uniform and dependable results. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combination of elements, arrangements of parts and in the several steps and relation and order of each of the same to one or more of the others all as will be illustratively described herein, 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,

Figure 1 is a plan view of the grinding apparatus in assembled relation;

Figure 2 is a partial front elevation on an enlarged scale of certain parts of the apparatus shown in Fig. 1, certain parts being shown in section and, more specifically, is a view taken on the line 2—2 of Fig. 4;

Figure 3 is a sectional view on an enlarged scale taken on the line 3—3 of Fig. 4; and

Figure 4 is a side elevation on an enlarged scale of certain parts of the apparatus shown in Fig. 1 as viewed from the right, certain parts being broken away to show the construction more clearly.

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

Turning now to the drawings and referring more particularly to Fig. 1, I have shown a main supporting frame or table 10 provided in its upper surface with longitudinally extending ways 11 and 12 in pairs, each adapted to support therein for slidable movement the carriages 13 and 14 respectively. The carriages 12 and 13 are provided at their adjacent ends with bearings 15 and 16, respectively, adapted to rotatably support therein the shafts 17 and 18 respectively. The shaft 17 has mounted upon one end thereof what will hereinafter be termed a regulating wheel 19, and the shaft 18 has mounted upon one end thereof what will hereinafter be termed a grinding wheel 20. The shafts 17 and 18 are provided with pulleys 21 and 22 respectively, by means of which the wheels 19 and 20 may be driven from any suitable source of power.

The wheels 19 and 20 may conveniently be made of a suitable abrasive material and it will be noted that they are mounted to present adjacent operative surfaces. Moreover, the shaft 17 with its associated regulating wheel 19 is driven at a relatively low speed and in the direction of the arrow shown in both Figs. 1 and 2, and the shaft 18 with its associated grinding wheel is driven at a relatively high speed or at a suitable grinding speed in the direction of the arrows shown in these two figures. As is more clearly shown in Fig. 2, it will be seen that the wheels 19 and 20 present adjacent operative surfaces 19^a and 20^a which gradually approach each other and which, by reason of the directions of rotation given the respective wheels, travel in opposite directions with respect to one another. At this point it may be further noted that I prefer to incline the axis of rotation of the regulating wheel 19 in a vertical plane so that, as viewed in the vertical plane, the axis of the wheel 19 makes a slight angle with the axis of the wheel 20. This I may conveniently accomplish by making the rear bearing 15 in which the shaft 17 of the regulating wheel 19 is mounted slightly higher

in elevation than the front bearing 15 supporting this shaft. For the sake of avoiding complexity of illustration, this relative inclination is not shown in Fig. 1 since it is preferably relatively slight, but, as will be more clearly hereinafter seen, the inclination of the regulating wheel 19 is more clearly shown in Fig. 4 of the drawings.

Referring still to Fig. 1 of the drawings, it will be seen that the carriages 14 and 13 may be positively moved in their respective ways 12 and 11 by means of suitable screws 24 and 25 manually controlled by the hand wheels 24^a and 25^a, respectively. The wheels 19 and 20 with their adjacent operative surfaces 19^a and 20^a may thus be moved toward or away from each other for purposes more clearly hereinafter set forth.

The wheels 19 and 20 I prefer to enclose within a housing generally indicated at 23 in Fig. 1 but shown broken away in this figure in order to show the relation of the wheels 19 and 20, the housing 23 being suitably secured to the front of the main frame 10 of the machine. Turning now to Fig. 4 of the drawings, part of this housing construction is more clearly shown in section and it will be seen that the housing 23 is provided with a front wall 23^a and a rear wall 23^b bridged by the rib 23^c between the wheels to form a horizontal supporting surface. Upon the latter rests a casing 26 in general of a cylindrical shape and bored out substantially cylindrically and throughout substantially its entire extent as indicated at 27. The casing 26 is plane-faced on its under side to rest upon the bridging rib 23^c and is provided at the forward end with a downwardly extending lug or plate member 28 by means of which the casing 26 with its associated parts may be rigidly mounted and secured in position. Thus the bolt 29 secures the lug 28 of the casing 26 to the front wall 23^a of the wheel housing 23, the latter thus functioning conveniently to support rigidly the casing 26 with associated parts between the two wheels 19 and 20.

Within the casing 26 and slidably supported within the interior cylindrical surface 27 thereof is a substantially cylindrical bar 30 provided at its forward end and upon the underside thereof with a rack 31 adapted to mesh with a gear 32. The gear 32, as is more clearly shown in Fig. 2, is mounted upon a stud shaft 33 to rotate therewith, the stud shaft being rotatably supported in the downwardly extending and spaced lugs 34 and 35 preferably integrally formed with the housing 26, the latter being suitably apertured to permit the gear 32 to extend therein to engage the rack 31. A handle 36 is suitably secured to one end of the stud shaft 33 so as to permit the gear 32 to be manually operated.

It will thus be seen that upon a clockwise rotation of the gear 32 in response to a like swinging of the arm 36 the bar 30 is moved in a direction to the right within the casing 26 and that upon a reverse movement of the gear 32 and the handle 36 the bar 30 is moved to the left or into the position shown in Fig. 4. It will be seen that the movement of the bar 30 as above described takes place in response to a substantially continuous movement of the gear 32 and its associated operating handle 36. Suitable caps 37 and 38 are mounted upon the respective ends of the casing 26 in order to close the ends thereof and thus to substantially entirely encase the movable bar 30 therein.

At two spaced points in the bar 30 and in the upper side thereof the bar 30 is provided with the inclined surfaces 39 and 40, the latter of which is more clearly shown in Fig. 4, the adjacent parts being broken away to show this construction more clearly. At two substantially similarly spaces points in the casing 26 there are provided the vertically extending and substantially cylindrical channels or openings 41 and 42 each adapted to receive the substantially cylindrical guiding portions 43^a and 44^a of a pair of posts 43 and 44, respectively. The guiding portions 43^a and 44^a of these two posts are slotted at their lower ends so as to straddle the bar 30, the latter being cut away upon its lateral sides and adjacent the inclined surfaces 39 and 40 in order that the bar 30 at these portions thereof may be accommodated within the slotted guiding portions 43^a and 44^a of the two posts 43 and 44. In Fig. 2 the guiding portion 43^a of the post 43 is shown slotted as at 43^b and in this figure also is shown more clearly the bar 30 cut away upon its lateral portion in order to permit the guiding portion 43^c to straddle the bar 30. The rotation of the bar 30 about its axis is thus prevented and the driving engagement of the gear 32 with the rack 31 may be effectively maintained.

The slotted portions of the guiding portions 43^a and 44^a of the posts 43 and 44 are adapted to coact with the inclined surfaces 39 and 40, respectively, so that upon movement of the bar 30 to the right as viewed in Fig. 4 the posts 43 and 44 will be given a substantially continuous movement in an upward direction and, upon a reverse movement of the bar 30 or into the position shown in Fig. 4, the posts 43 and 44 will be simultaneously moved downwardly as seen in this figure. For the sake of greater clarity of expression, these movements of the posts 43 and 44 with their associated parts in response to the actuating mechanism will be hereinafter termed, respectively, outward and inward, reference being had more particularly to Fig. 2 of the drawings wherein these movements are respectively in such direction as to carry

the associated parts outwardly and inwardly with respect to the approaching operative surfaces 19ª and 20ª of the wheels 19 and 20.

Adjacent the vertically extending cylindrical openings 41 and 42 in the casing 26, the latter is extended upwardly to form the sleeves 26ª and 26ᵇ to insure the proper guiding of the posts 43 and 44 in their movement as hereinbefore described; and it will be further noted that the latter are provided with downwardly extending skirt portions 43ᵇ and 44ᵇ, respectively, adapted to overlap the upwardly extending sleeve portions 26ª and 26ᵇ, respectively. It will also be noted that these skirts are preferably of sufficient length to insure the lateral overlapping throughout substantially the entire range of movement of the posts 43 and 44. It will thus be seen that the actuating mechanisms hereinbefore described are thus substantially entirely encased and that the relatively moving surfaces of the actuating mechanism are well protected against access thereto of foreign matter.

The posts 43 and 44 are adapted to support a guiding bar 45 preferably of rectangular cross section and I prefer to secure the bar 45 to the posts 43 and 44 by means of the bolts 46 and 47 each adapted to secure one end of the guiding bar 45 to one of the posts. Moreover, I prefer to slot the posts 43 and 44 in a vertical direction as at 43ᶜ and 44ᶜ, respectively, the bolts 46 and 47 passing through these slots in order that each end of the guiding bar 45 may be independently vertically adjustable within its respective posts.

On the respective ends of the guiding bar 45 and upon the lateral sides thereof I attach vertically projecting pairs of plates 48 and 49, the former being more clearly shown in Fig. 2 in order to form with the bar 45 a guiding way extending longitudinally of the bar 45. Resting upon the bar 45 and between the respective members of the pairs of plates 48 and 49 is a carriage 50 which may conveniently take the form of a substantially rectangularly shaped bar (see Fig. 2) snugly fitting within the guiding ways provided by the bar 45 and associated parts in order that the carriage 50 may partake of a movement with respect to the guiding bar 45 in a path predetermined thereby, it being noted that this movement may take place in a direction substantially in a horizontal plane where the guiding bar 45 is adjusted horizontally with respect to the two posts 43 and 44 or in a direction making an angle with the horizontal where the respective ends of the guiding bar 45 are independently adjusted with respect to the posts 43 and 44 to different heights. The carriage 50 is recessed at an intermediate portion thereof, as at 50ª, and at two spaced points within the recessed portion 50ª there are mounted within the carriage 50 two upwardly extending pins 51 and 52, the latter of which is more clearly shown in Fig. 3 of the drawings. A work support 53 is adapted to be received within the recessed portion 50ª of the carriage 50 and, as shown in Fig. 4, is preferably of a lesser extent than the extent of the recessed portion 50ª in order that one end of the work support 53 may be spaced from an abutment 54 preferably integrally formed with the carriage 50 and adjacent one end of the recessed portion 50ª. As is more clearly shown in Fig. 3, the work support 53 is preferably of less width than the width of the carriage 50, and upon the under side of the work support 53 are provided two recesses 53ª and 53ᵇ adapted to receive the pins 51 and 52, respectively. The recesses, moreover, are materially larger than their respective pins received therein, as is clearly shown in Fig. 3, in order that the work support 53 may be loosely supported upon the carriage 50. Moreover, it will be seen that by so connecting the work support 53 with the carriage 50 the former may partake of a relative lateral or angular movement with respect to the latter for purposes to be more clearly hereinafter set forth.

The upper part of the work support 53 is provided with a substantially V-shaped groove extending throughout its length, generally indicated in Fig. 3 at 53ᶜ, adapted to rotatably support the cylindrical portion 55ª of the work generally indicated at 55. The work or body intended to be operated upon is herein illustratively shown as taking the form of a bolt having a shank portion 55ª which it is intended to grind substantially cylindrical and a head 55ᵇ of greater diametrical extent than the portion 55ª. The work support 53, (see Fig. 4) may thus support the work 55, the portion such as the head 55ᵇ of greater diametrical extent than the cylindrical portion being accommodated in the recessed portion 50ª of the carriage 50. The V-shaped groove 53ᶜ of the work support 53 thus rotatably supports the work and determines the axis of rotation of the work with respect to the work support 53 itself. Moreover, the work may thus be dependably supported when out of operative relation to the operative surfaces of the two wheels or when, as will be more clearly hereinafter set forth, the carriage 50 with the work support 53 is moved to carry the work out of contact with the operative surfaces.

Referring to Fig. 3, it will be seen that the bottom of the V-shaped groove 53ᶜ is provided with a recess 53ᵈ extending throughout the length of the work support 53 in order to make ample provision for accommodating foreign matter, such as the

particles of the material removed from the work or particles from the wheels, which might otherwise detrimentally affect the proper supporting of the work in the work support.

Further features of construction will be clearly understood, it is believed, in connection with the description of the operation of the apparatus, which may now be considered. The guiding bar 45 is preferably adjusted within the posts 43 and 44 so as to assume a position substantially in the horizontal plane, and the wheels 19 and 20 are rotated preferably as hereinbefore described, it being understood that the path of travel of the operative surface of the regulating wheel 19 is inclined with respect to the path of travel of the carriage 50 as determined by the guiding bar 45. This inclination, it will be understood, may conveniently be obtained by inclining the axis of the regulating wheel 19 with respect to the axis of the grinding wheel 20, this relative inclination being more clearly shown in Fig. 4. Moreover, the degree of inclination may be readily adjusted at will and may be made greater or less than that illustratively set forth in Fig. 4 by inclining the guiding bar 45 with respect to the horizontal within the supporting posts 43 and 44.

The actuating mechanism, including the bar 30 and the operating handle 36, is operated to carry the guiding bar 45 with its associated carriage 50 to its uppermost position, and the work illustratively shown as a bolt 55 is placed in the V groove 53^c of the work support 53, the work support acting to rotatably support the work out of operative relation to the approaching operative surfaces of the two wheels. As shown in Fig. 4 there is provided in the abutment 54 an adjustable stop conveniently taking the form of a screw 54^a adapted to engage the end of the work 55 to prevent movement of the latter in the direction of its axis with respect to the work support 53. The adjustable stop 54^a may be moved toward or away from the work support 53 in order to accommodate within the intervening recess portion 50^a of the carriage 50 the enlarged portion 55^b of the work which, it will be understood, may in practice vary in its length along the axis of the work. The stop 54^a, moreover, is preferably so adjusted that the cylindrical portion 55^a of the work 55 is substantially entirely supported within the V groove of the work support 53 in order to insure a positive support of the work during the action thereon of the wheels. A lock nut 54^b is provided to lock the stop 54^a in adjusted position.

The carriage 50 is thereupon moved to the right and substantially into the position shown in Fig. 4, wherein it will be noted that the enlarged portion 55^b of the work 55 is positioned exterior of the operative surfaces of the two wheels. At the left-hand end of the carriage 50 is mounted a downwardly extending lug 50^b within the lower end of which is threaded an adjustable stop conveniently taking the form of a screw 50^c adapted to abut against the left-hand end of the guiding bar 45. The extent of movement toward the right of the carriage 50 may thus be adjusted and limited to insure holding the enlarged portion 55^b of the work 55^a out of operative relation to the operative surfaces of the two wheels. A lock nut 50^d is conveniently employed to hold the stop 50^c in its adjusted position.

The actuating mechanism is thereupon operated in a reverse direction and into the position substantially as shown in Fig. 4, whereby the guiding bar 54 with its associated carriage 50 is given a substantially continuous inward movement between the approaching operative surfaces of the two wheels, suitable pairs of springs 56 and 57 engaging at their respective ends the guiding bar 54 and the casing 26 acting to insure the full extent of such inward movement of the above-mentioned parts. Suitable stops adjustably mounted in the upper part of the casing 26 and at the respective ends thereof act to limit the extent of inward movement given the above-mentioned parts and conveniently take the form of cap screws 58 and 59 threaded into the bosses 60 and 61 respectively in the upper parts of the casing 26. The adjustable stops or screws 58 or 59 are positioned in the path of inward movement of the guiding bar 45 and it will be noted that each engages the bar 45 at one end thereof so that the bar 45 is rigidly and dependably supported at its innermost position. The lock nuts 58^a and 59^a are associated with the adjustable stops 58 and 59, respectively, to lock the latter in adjusted position. It will be understood, of course, that these stops may be adjusted to such heights independently of one another as to halt the guiding bar 45 at the proper inclination, if any, with respect to the horizontal at which the bar 45 had been previously adjusted within the posts 43 and 44.

As the carriage 50 is thus moved inwardly between the operative surfaces of the two wheels 19 and 21, the cylindrical portion 55^a of the work 55 is presented to the adjacent and opposite operative portions of the operative surfaces and the action of the portions upon the portion 55^a at once begins. It will be noted, however, that during the inward movement of the work between the approaching operative surfaces the work is rotatably supported in the work support 53 and has its axis of rotation substantially fixed with respect thereto. This axis, however, may or may not be properly aligned

with respect to the opposed operative portions of the wheels but during its inward movement, the work upon engaging the operative portions of the two wheels is aligned thereby; and as the work is aligned, the work support 53 is aligned therewith, partaking of whatever degree of lateral or angular movement with respect to the carriage 50 that may be necessary. The inclined faces of the V groove 53c each contact with the cylindrical portion of the work, but as the work support is aligned as above noted the two points of contact or support of the work with the inclined surfaces of the V groove act in effect as a single point of contact so that with the two points or lines of contact of the respective wheels accuracy of grinding action is not impaired.

The operative portion of the regulating wheel 19 acts to control the rotation of the work upon its work support during the action thereon by the operative portion of the grinding wheel 20. Moreover, by reason of the relative inclination that exists between the path of travel of the operative surface of the regulating wheel 19 and the path of travel provided for the carriage 50 in the guiding bar 45, the regulating wheel 19 exerts a lateral thrust which acts in a direction toward the left as viewed in Fig. 4. The work 55 is thus not only rotated but is also moved along in the direction of its axis or to the left and carries with it the carriage 50. The grinding action thus continues until the carriage 50 is moved along the guiding bar 45 and toward the left in Fig. 4 to such a distance that the cylindrically ground portion of the work 55 has emerged from the operative portions of the two wheels. The rate at which this feeding is carried on may be readily adjusted at will by varying the relative inclination between the paths of travel of the operative surface of the regulating wheel 19 and of the carriage 50 as hereinbefore already set forth.

The grinding operation having been completed, the actuating mechanism is thereupon operated to move the guiding bar 45 with the carriage and associated parts in its outermost position, whereupon the work just operated upon is removed and replaced by the next piece of work to be subsequently acted upon. The carriage 50 is thereupon manually moved to the right, as viewed in Fig. 4, to position the cylindrical portion 55a of the new piece between more distant portions of the approaching operative surfaces of the two wheels, the stop 50c acting to limit this movement of the carriage 50 to insure the positioning of the enlarged or headed portion 55b of the work exterior of the surfaces of the wheels. The actuating mechanisms, including the bar 30 and the operating handle 36, are thereupon operated to move the work 55 inwardly to be automatically aligned with the operative portions of the surfaces and to be operated upon thereby in the manner already above described, whereupon the above described cycle of operations is repeated. It may be noted that when it is desired to grind articles of greater diameter than that hereinabove assumed, the wheels 19 and 20 may be adjusted or moved away from each other by means of the hand wheels 25a and 24a respectively in order that the opposed operative portions of the surfaces of the two wheels will be effective to cause the grinding action to take place to the desired larger diameter. Moreover when work of larger diameter is desired to be operated upon it may be advantageous to lower the guiding bar 45 in the supporting posts 43 and 44 or to lower the stops 58 and 59 to permit the work of larger diameter to be presented to the desired operative portions of the operative surfaces of the two wheels. Vice versa, when work of smaller diameter is desired to be operated upon the reverse adjustments may be readily carried out.

It will be seen that the apparatus herein provided is of convenient manipulation, the operator being positioned normally at the front of the machine or at the left-hand end of the apparatus as viewed in Fig. 4. The operator may thus conveniently position the work on and remove it after operation from the work support, and it will furthermore be noted that I prefer to provide the carriage 50 at its end nearest the operator with a handle, indicated at 50g, whereby the operator may not only move the carriage 50 into the position determined by the adjustable stop 50c prior to moving the guiding bar 50 with its carriage and work inwardly to the wheels, but also may thereby manually control the movement of the carriage 50 during the grinding action thereon by the grinding wheel. The operator may thus manually determine the rate at which the carriage 50 is moved with the work thereon out of operative relation from the two wheels.

It will moreover be noted that as the work 55, and particularly so when the work is relatively long, is being presented to the operative portions of the two wheels as hereinbefore described and fed to the left as viewed in Fig. 4 during the action thereon of the two wheels, the right-hand ends of the operative portions of the two wheels (also as viewed in Fig. 4) are caused to operate upon the work to a greater extent than the left-hand end portions. In other words, the removal of the material from the work to bring the latter to the desired diameter is accomplished on the major portion of the work by the right-hand end portions of the wheels, thus relieving the left-

hand end portions through which the work emerges from the greater burden of grinding and controlling. The left-hand end portions thus are least subjected to wear and effectively make for greater uniformity and accuracy of result.

It will thus be seen that there has been provided in this invention an apparatus and art for grinding irregularly shaped bodies, a portion of which is of circular section, in which the several objects hereinbefore set forth and many advantages are effectively achieved. It will be noted that the apparatus is simple in manipulation and is of rugged construction and dependable action so that accuracy of action, as well as uniformity of output, is readily attained.

As many possible embodiments may be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In apparatus of the general nature of that herein described, in combination, a pair of wheels one of which has an abrasive surface, said wheels presenting approaching operative surfaces and adapted to present opposed operative portions for action on work presented thereto, a carriage extending between said wheels and having a portion for supporting a round part of a work piece and provided with means forming an adjustable gap into which may be accommodated an enlarged part of the work piece, and means mounting said carriage between said wheels and adapted to permit movement thereof in a direction substantially coincident with the axis of the work piece supported thereon.

2. In apparatus of the general nature of that herein described, in combination, a grinding wheel having an operative abrasive surface, a carriage adapted to be moved in a substantially fixed path relative to the operative surface of said grinding wheel, means on said carriage and movable therewith adapted to rotatably support a cylindrical body and to substantially fix its axis of rotation with respect thereto, and means mounting said body-supporting means on said carriage to permit said supporting means with said body thereon to align itself with respect to the operative surface of said grinding wheel as said carriage is moved with respect to said grinding wheel.

3. In apparatus of the general nature of that herein described, in combination, a grinding wheel having an operative abrasive surface, a carriage adapted to be moved relative to the operative surface of said grinding wheel, means on said carriage and movable therewith and having a substantially V-shaped upper portion for rotatably supporting a round body, means for guiding said movable carriage in a direction to carry said body into operative relation to said operative surface, and means mounting said body-supporting means on said carriage to permit said supporting means with said body thereon to align itself with respect to the operative surface of said grinding wheel.

4. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present operative surfaces traveling in opposite directions and to present opposed operative portions thereof to work presented thereto, a carriage adapted to be moved between said wheels, means on said carriage and movable therewith adapted to rotatably support a substantially cylindrical body and to substantially fix its axis of rotation with respect thereto, and means mounting said supporting means on said carriage adapted to permit said supporting means with said body thereon to align itself with respect to said opposed operative portions of said operative surfaces as said carriage is moved to present said body to said operative portions.

5. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present operative surfaces traveling in opposite directions and to present opposed operative portions thereof to work presented thereto, a carriage adapted to be moved between said wheels and in a direction substantially parallel to the direction of said opposed operative portions, the path of travel of the operative surface of said regulating wheel making an angle with the direction of movement of said carriage, means on said carriage and movable therewith adapted to rotatably support a cylindrical body and to substantially fix its axis of rotation with respect thereto, and means mounting said supporting means on said carriage adapted to permit said supporting means with said body thereon to align itself with said opposed operative portions of said surfaces, said regulating wheel acting to control the rotation of said body on said supporting means and to feed said body with said carriage relative to the operative surface of said grinding wheel.

6. In apparatus of the general nature of that herein described, in combination a

grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present operative surfaces traveling in opposite directions and to present opposed operative portions thereof to work presented thereto, a carriage adapted to be moved between said wheels, means on said carriage and movable therewith adapted to rotatably support a substantially cylindrical body and to substantially fix its axis of rotation with respect thereto, and means mounting said supporting means on said carriage adapted to permit relative lateral movement to take place between said supporting means and said carriage thereby to align said supporting means with respect to said opposed operative portions of said surfaces.

7. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a carriage adapted to be moved transversely of itself and upon such movement to approach the operative surface of said grinding wheel, means on said carriage and movable therewith adapted to rotatably support a cylindrical body and to substantially fix its axis of rotation with respect thereto, and means mounting said body-supporting means on said carriage to permit said supporting means with said body thereon to align itself with respect to the operative surface of said grinding wheel as said carriage is moved to present said body to the operative surface of said wheel.

8. In apparatus of the general nature of that herein described, in combination, a pair of wheels one of which has an abrasive surface, said wheels presenting approaching operative surfaces and adapted to present operative portions for action on work presented thereto, a carriage adapted to extend between the approaching operative surfaces of said wheels, means for moving said carriage toward less distant portions of the operative surfaces of said wheels, means on said carriage adapted to rotatably support a cylindrical body and to substantially fix its axis of rotation with respect thereto, means mounting said supporting means on said carriage adapted to permit said supporting means with said body thereon to align itself with said opposed operative portions of said surfaces as said carriage is moved, and means adapted to permit movement of said carriage with said body supported thereon in a direction substantially coincident with the axis of said cylindrical body.

9. In apparatus of the general nature of that herein described, in combination, a grinding wheel adapted to be rotated at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present operative surfaces traveling in opposite directions and to approach each other and to present also opposed operative portions of work presented thereto, a carriage adapted to extend between said approaching operative surfaces of said wheels, means for moving said carriage in a direction toward less distant portions of said approaching operative surfaces, means on said carriage adapted to rotatably support a cylindrical body and to substantially fix its axis of rotation with respect thereto, means mounting said supporting means on said carriage adapted to permit said supporting means with said body thereon to align itself with said opposed operative portions as said carriage is moved to present said body thereto, and means for guiding said carriage in a direction substantially coincident with the axis of said body, the path of travel of the operative surface of said regulating wheel making an angle with the path of travel of said carriage, said regulating wheel governing the rotation of said body and acting to feed said body with said carriage along said guiding means.

10. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, a carriage adapted to extend between said wheels to support thereon a cylindrical body having a portion of greater diametrical extent than said body, said carriage having a recess for accommodating said portion of said body of greater diametrical extent, and means for moving said carriage between said approaching operative surfaces and toward said opposed operative portions thereof with said enlarged portion of said body exterior of said surfaces to present said cylindrical body to said opposed operative portions.

11. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, a movable carriage extending between said wheels adapted to support a body having a cylindrical portion and an enlarged end portion, said carriage being recessed to accommodate said enlarged end portion of said body, means for moving said carriage between said approaching operative surfaces and in a direction toward said opposed operative portions thereof with said enlarged end portion

of said body exterior of said operative surfaces to present said cylindrical portion to said opposed operative portions, and means for guiding said carriage in a direction substantially coincident with the axis of said cylindrical portion of said body, the path of travel of the operative surface of said regulating wheel making an angle with the path of travel of said carriage in said guiding means, said regulating wheel acting to control the rotation of said body and acting to feed said body and said carriage along said guiding means and in a direction toward said enlarged portion of said body.

12. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, guiding means extending between said wheels, a carriage mounted in said guiding means adapted to support a cylindrical body and movable therein in a direction substantially coincident with the axis of said cylindrical body, and means for moving said guiding means with said carriage supported thereon in a direction to move said carriage between said approaching operative surfaces to present said body supported thereon to said opposed operative portions thereof.

13. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, guiding means extending between said wheels, a carriage mounted in said guiding means and movable thereon adapted to support a cylindrical body the path of travel of said carriage in said guiding means making an angle with the path of travel of the operative surface of said regulating wheel, a stop on said carriage adapted to engage said cylindrical body at one end thereof, and means for moving said guiding means with said carriage supported thereon inwardly between said approaching operative surfaces to present said body to said opposed operative portions thereof, said regulating wheel acting to control the rotation of said body and to feed said body and said carriage along said guiding means.

14. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, a work support having a V-shaped groove for rotatably supporting therein a cylindrical body, a carriage adapted to be moved inwardly between the operative surfaces of said wheels, and means mounting said work support on said carriage to permit said work support with said body thereon to align itself with respect to said opposed operative portions of said surfaces as said carriage is moved to present said body to said operative portions.

15. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, a work support having a V-shaped groove for rotatably supporting a substantially cylindrical body therein, guiding and supporting means extending between said wheels for supporting said work support, said guiding means providing a path of travel between said wheels for said work support making an angle with the path of travel of the operative surface of said regulating wheel, means for moving said guiding and supporting means inwardly between said approaching surfaces to present said cylindrical body to the operative portions of said surfaces, and means mounting said work support upon said guiding and supporting means to permit said work support to align itself with said body supported thereon with respect to said operative portions of said surfaces, said regulating wheel acting to control the rotation of said body and to feed said body and said work support along said guiding means.

16. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, a movable carriage extending between said wheels adapted to support a body having a cylindrical portion and an enlarged end portion, said carriage being recessed to accommodate said enlarged end portion of said body, means for moving said carriage between said approaching operative surfaces and in a direction toward said opposed operative portions thereof with said enlarged end portion of said body exterior of said operative surfaces to present said cylindrical portion to said opposed operative portions, and

means for adjusting the position of said carriage with respect to said moving means to position the enlarged end portion of said body supported on said carriage exterior of said operative surface.

17. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, a movable carriage extending between said wheels adapted to support a body having a cylindrical portion and an enlarged end portion, said carriage being recessed to accommodate said enlarged end portion of said body, means for guiding said carriage inwardly between said approaching operative surfaces and in a direction toward said opposed operative portions thereof to present said cylindrical portions to said opposed operative portions, guiding means extending between said wheels adapted to form a path of travel for said carriage, said path of travel making an angle with the path of travel of the operative surface of said regulating wheel, whereby said regulating wheel acts to control the rotation of said body and to feed said body with said carriage along said last-mentioned guiding means and in a direction toward said enlarged end portion of said body, and means for limiting the reverse movement of said carriage in said last-mentioned guiding means to position said carriage to carry said body upon movement thereof in said first guiding means with said enlarged end portion exterior of said operative surfaces.

18. In apparatus of the general nature of that herein described, in combination, a grinding wheel rotatable at relatively high speed, a regulating wheel rotatable at relatively low speed, said wheels being adapted to present approaching operative surfaces traveling in opposite directions and to present opposed operative portions of said surfaces to work presented thereto, guiding means extending between said wheels adapted to form a path of travel making an angle with the path of travel of the operative surface of said regulating wheel, a carriage mounted in said guiding means adapted to support a cylindrical body, means for moving said guiding means with said carriage supported thereon inwardly between said approaching operative surfaces to present said body supported thereon to said opposed operative portions thereof, said regulating wheel acting to control the rotation of said body and to feed said body and said carriage along said guiding means, and means for limiting the inward movement of said guiding means.

In testimony whereof, I have signed my name to this specification this twenty-first day of August 1922.

LEWIS R. HEIM.