Nov. 1, 1927. 1,647,131

L. R. HEIM

GRINDING

Filed Jan. 29, 1925 2 Sheets-Sheet 1

Fig. 1.

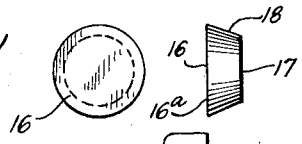


Fig. 2.

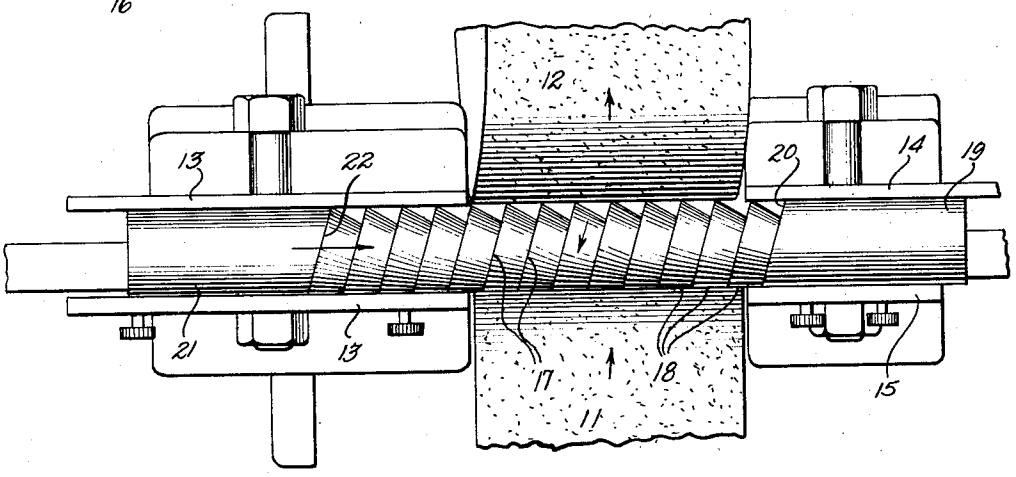
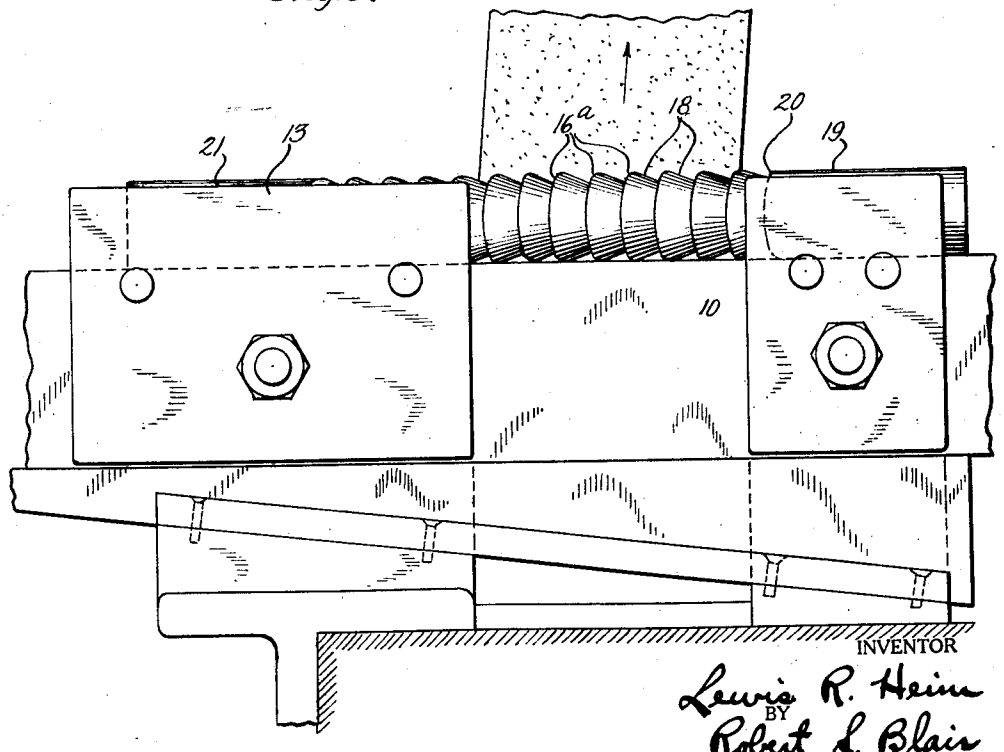


Fig. 3.



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Fig. 4

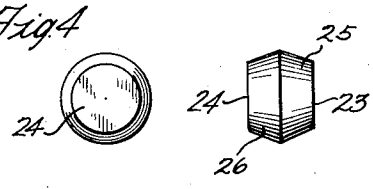


Fig. 5

Fig. 6.

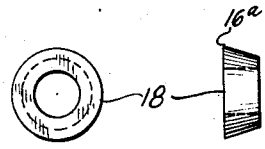


Fig. 7.

Fig. 8.

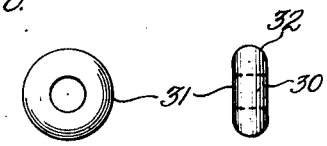
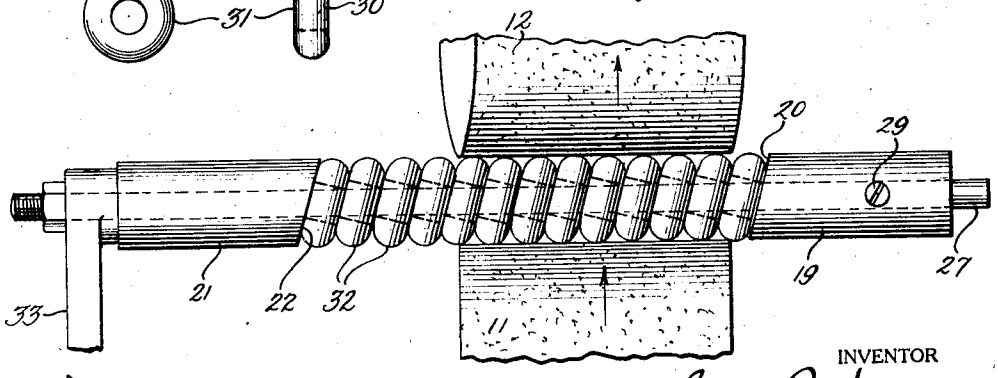


Fig. 9



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UNITED STATES PATENT OFFICE.

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GRINDING.

Application filed January 29, 1925. Serial No. 5,567.

This invention relates to the art of grinding and more particularly to the art of centerless grinding. One of the objects of the invention is to provide a practical art of the above nature particularly adapted for grinding articles upon surfaces thereof inclined with respect to the principal axes of the articles. Another object is to provide an art of the above nature capable of being rapidly carried on and productive of results of extreme accuracy. Another object is to provide an art of the above nature for grinding work having short length relative to its diameter and the diameter of which varies along its length. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the several steps, the combinations of steps and relation of one or more of the same to the others thereof, all as will be illustratively herein described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing in which are illustrated various possible methods of carrying out this invention,

Figure 1 shows two different elevations of an article to be ground;

Figure 2 is a plan view of an apparatus for grinding articles, such as shown in Fig. 1;

Figure 3 is a side elevation of the apparatus shown in Fig. 2, with one of the wheels thereof removed;

Figure 4 shows an article of a different shape which is adapted to be ground;

Figure 5 is a somewhat diagrammatic plan of an apparatus grinding articles of the nature of that shown in Fig. 4;

Figure 6 shows an article of another form adapted to be ground;

Figure 7 is a view similar to Fig. 5 showing the grinding of articles such as shown in Fig. 6;

Figure 8 shows still another form of article adapted to be ground, and

Figure 9 is a view similar to Figs. 5 and 7 illustrating the grinding of articles such as that shown in Fig. 8.

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

Considering first the structure of the apparatus employed in carrying out the process of this invention, referring first to Figures 2 and 3, there is shown at 10 a support upon which the work rests while traveling through the grinding apparatus and being operated upon thereby. Positioned at one side of this support is a grinding wheel 11 driven at a high rate of speed in such direction that its operative face will move downwardly or toward the support 10, as indicated by the arrow, Fig. 1. On the opposite side of the support is a regulating wheel 12 which travels in the opposite direction, that is, its active surface moves upwardly or away from the support. The regulating wheel 12 moves at a slow rate of speed, preferably at such a rate that there is no material slip between its surface and the work which it engages.

The regulating wheel 12 is set at an angle, as indicated in the drawing, with respect to the supporting surface of the work support 10, so that there will be a component of its action lengthwise of the support tending to feed the work in the direction indicated by the arrow in Figure 2. The regulating wheel 12 thus not only feeds the work, but causes it to rotate at the desired rate of speed while the grinding wheel, driven at the best peripheral speed for grinding action, does its work on the articles which are rotated and fed past it.

As herein shown, these wheels, the grinding wheel 11 and the regulating wheel 12, are of the peripheral type as certain advantages are inherent in that type, but it is to be understood that many features of this invention comprehend the use of apparatus in which grinding wheels of other forms are employed.

At each side of the entering end of the work support 10 are positioned guides 13 which tend to hold the work in proper position to enter into the grip of the wheels. In similar manner at the discharge end of the work support 10 are positioned on opposite sides guides 14 and 15, the guide 15 being preferably shorter than the guide 14 to permit the work to be laterally removed, if desired.

The details of the construction, mounting and adjustments of the parts just described are not shown in detail and will not be described in detail, since of themselves they

form no part of the present invention. It will be seen, however, that the apparatus above described is capable of receiving various articles of work and automatically moving them along between the grip of the wheels 11 and 12, the regulating wheel 12 rotating the work and moving it along and the grinding wheel 11 grinding the surface of the work which engages the same, into true form. If the work being ground is cylindrical, it is ordinarily passed axially between the wheels, and its longitudinal axis about which it rotates is hence substantially parallel with its line of movement.

Referring now to Figure 1, there is shown an article which is not cylindrical in shape, its diameter at its end face 16 being greater than its diameter at its opposite end face 17. The outer face 18 thereof is desired to be ground down to true shape. Referring now to Figures 2 and 3, there is shown a method of accomplishing this result. As shown in Figure 2, a number of the pieces of work are placed face to face upon the work rest 10 and in advance thereof is placed a member 19 of any desired cross-section having a rear inclined face 20 against which the forward face of the foremost piece of work rests. At the rear of the work is positioned a second member 21 of any desired cross-section having a forward face 22 against which the rear face 16 of the rearmost piece of work rests. The face 22 is inclined at the same angle as is the face 20 of the member 19 and the two members 19 and 21 are so positioned with respect to each other that the two faces 20 and 22 lie in parallel planes. These two members 19 and 21 loosely hold the pieces of work against each other and in tilted position so that their surfaces 18 to be ground rest flatly against the surface of the grinding wheel 11, as shown in the plan view of Fig. 2. The pieces of work are thus held with their axes in tilted position with respect to their line of movement and with their surfaces 18 in proper position for being ground by the grinding wheel 11 as the work is rotated by the regulating wheel 12. The members 19 and 21 are suitably held against rotation, but are permitted lengthwise movement with the work as the latter is fed through the apparatus. The members 19 and 21, as was mentioned, simply loosely support the pieces of work in the tilted positions shown, permitting free rotation of the work by the regulating wheel.

The wheels 11 and 12 are so spaced that the regulating wheel 12 contacts the rear edges 16[a] of the pieces of work, rotating them as has been described, as they move between the wheels. The work is thus moved through the apparatus, rotated about an axis inclined or tilted with respect to its line of movement, and the surfaces 18 thereof are ground true to form by the grinding wheel 11.

The procedure preferably employed in grinding work as above described is to first position the members 19 and 21, with the interposed pieces of work, between the guides 13, the faces 20 and 22 being positioned in parallel planes and so as to support the pieces of work with respect to the wheels, as shown in Figures 2 and 3. The members 19 and 21 are then suitably held against rotation and by thrusting forwardly upon the member 21 the parts are moved in between the wheels, the pieces of work being rotated and ground upon their surfaces 18, as described. The members 19 and 21, it will be understood, are of such diameter that they are not engaged by the wheels, and they are easily held against rotation by suitable means. The pieces of work following the member 19 and followed by the member 21 emerge into the guides 14 and 15 with their surfaces 18 ground to true form.

Referring now to Figure 4, there is shown a form of article whose diameter is the same at each end 23 and 24 thereof, and which is of greater diameter at the middle, having two sloping surfaces 25 and 26 which are adapted to be ground. Articles of this shape are ground by the method illustrated in the plan shown in Figure 5. The same type of end members 19 and 20 are employed as have been described in connection with Figures 2 and 3, being provided with suitably inclined end surfaces 20 and 22 respectively. In grinding pieces of work of this shape, the pieces are first fed through between the wheels supported in such position by the members 19 and 20 that their surfaces 25 contact the grinding wheel 11 to be ground and their surfaces 26 contact the regulating wheel 12 for rotation of the work. Upon emerging from the wheels the pieces of work are again fed therethrough, this time with their surfaces 26 contacting the grinding wheel 11 to be ground and with their surfaces 25 contacting the regulating wheel 12. Thus, with these two passages of the pieces of work between the wheels, they emerge with their two surfaces 25 and 26 ground true to form. With this method of grinding, as with that first described, it will be understood, the two members 19 and 20 are held against rotation while the pieces of work therebetween are permitted entire freedom of rotation under the urge of the regulating wheel 12. Also the work moves through the machine with its axis inclined with respect to its direction of movement.

In Figure 6 there is shown a piece of work having a shape substantially the same as that of the piece shown in Figure 1, the same reference characters being employed to indicate the corresponding parts thereof. This piece of work shown in Figure 6,

however, has an axial opening therethrough. In grinding the surface 18 of work of this character, the method illustrated in Figure 7 may be employed. The two members 19 and 21 having the corresponding sloping end surfaces 20 and 22 are in this instance provided with axial openings therethrough. Passing through these openings is a rod 27 upon which is threaded a nut 28 exterior of the member 21. The member 19 is adjustable along the rod 27 and adapted to be fixed in position thereon by a set screw 29. The articles to be ground are placed upon the rod 27 between the two members 19 and 21, the latter members being then adjusted along the rod so that the pieces of work are held against each other and yet permitted freedom of rotation upon the rod. When the pieces of work are thus positioned between the two sloping surfaces of the members 19 and 21, they are held in the inclined positions shown, the surfaces 20 and 22 being in parallel planes and positioned so that the surfaces 18 to be ground all will rest flatly against the surface of the grinding wheel 11. The rod 27 is of substantially smaller diameter than the diameter of the openings through the pieces of work to permit the proper tilting of the pieces upon the rod. The shaft 27 is suitably held against rotation, and the assembled parts comprising the rod, the members 19 and 21, and the pieces of work therebetween are fed through between the wheels. The regulating wheel 12 contacts the edges 16^a of the pieces of work to rotate the work as the surfaces 18 are ground, and to feed the work through.

Referring now to Figure 8, there is shown another form of article to be ground, this form having equal diameters at its two ends 30 and 31 and having a rounded periphery 32 adapted to be ground. This piece of work is also provided with an axial opening therethrough. The method employed in grinding articles of this nature is that illustrated in Figure 9. The rod 27 is employed as in the apparatus of Figure 7, together with the members 19 and 21 removably mounted thereon as has been described. The articles to be ground are supported upon the rod 27 between the sloping surfaces 20 and 22 of the members 19 and 21, being thereby supported in inclined position as shown, their rounded peripheries 32 engaging the grinding wheel 11 and the regulating wheel 12. In grinding these pieces of work the supporting members 19 and 21 are not held against rotation, as they are in the methods before described, but they are rotated as the work passes through between the wheels. As one way of accomplishing such rotation, a suitable handle 33 is secured upon the rod 27 in place of the nut 28. As the work is fed through the machine the rod 27, together with the members 19 and 21, are slowly rotated by means of the handle 33.

The regulating wheel 12 continually rotates the work as it is fed between the wheels, this rotation being about the rod 27 and relative to the members 19 and 21 and to the rod 27. The sloping surfaces 20 and 22 continually hold the pieces of work with their longitudinal axes about which they rotate inclined with respect to the line of movement of the work or with respect to the axis of the rod 27 and the members 19 and 21. At the same time, the rod and the members 19 and 21 fixed thereon are rotated by the handle 33, and the pieces of work held between the sloping surfaces are moved by this rotation in addition to their rotation about and relative to the rod 27 under the urge of the regulating wheel. The effect of the rotating members 19 and 21 is to shift the axes of rotation of the work pieces during their rotation, and there consequently results a shifting of the contact of the grinding wheel against the work laterally back and forth across the rounded peripheries of the pieces of work as they are fed between the wheels and rotated by the regulating wheel. The contact of the regulating wheel against the work also shifts laterally back and forth across the rounded peripheries of the pieces of work. The pieces of work thus emerge from between the grinding and regulating wheels with their rounded peripheries 32 ground to true form by the grinding wheel.

From the above it will be seen that there is herein provided an art of grinding attaining the objects of this invention, accomplishing many advantages of novelty and of great practical importance. The processes described above may be carried on with great rapidity and the work operated upon is ground with the highest accuracy.

As various changes might be made in the art herein described, and as the invention might be carried on with various forms of apparatus, 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. The herein described art of grinding which consists in placing work of short length relative to its diameter between the operative faces of grinding and regulating wheels, said work being ground by said grinding wheel and rotated by said regulating wheel, and holding against said work a member of greater length than said work and having an end face inclined with respect to the adjacent operating surfaces of said wheels, said face resting snugly against an end face of the work.

2. The herein described art of grinding which consists in feeding work of short length relative to its diameter between and across the operative faces of grinding and regulating wheels and maintaining against one end of the work during its passage between said wheels a surface in a plane angularly disposed to the line of movement of the work.

3. The herein described art of grinding which consists in placing work of short length relative to its diameter between the operative faces of grinding and regulating wheels, said work being ground by said grinding wheel and rotated by said regulated wheel, and accompanying said work by a cylindrical member having an end face inclined with respect to the adjacent operating surfaces of said wheels, said face resting against an end face of the work.

4. The herein described art of grinding which consists in supporting in operative relation to a grinding wheel a succession of articles of short length positioned end to end, rotating said articles as they are operated upon by said grinding wheel, and holding against one of the endmost articles a member of greater length than that of said articles and having an end face inclined with respect to the operating surface of said grinding wheel, said end face fitting snugly against the end face of said endmost article.

5. The herein described art of grinding which consists in feeding work of short length relative to its diameter between and across the operative faces of grinding and regulating wheels, said work being ground by said grinding wheel and rotated by said regulating wheel, and holding said work with its axis of rotation inclined with respect to its line of movement as it is thus fed and acted upon by said wheels.

6. The herein described art of grinding which consists in feeding between and across the operative faces of grinding and regulating wheels a succession of articles of short length relative to their diameters and positioned end to end, said articles being ground by said grinding wheel and rotated by said regulating wheel, and holding said articles with their individual axes of rotation substantially parallel to one another but inclined with respect to their line of movement as they are thus fed and acted upon by said wheels.

7. The herein described art of grinding which consists in feeding work along a predetermined path between grinding and regulating wheels, said work being rotated and ground thereby, and shifting the axis of rotation of the work as it is thus acted upon by said grinding and regulating wheels.

8. The herein described art of grinding which consists in feeding work along a predetermined path between grinding and regulating wheels, said work being rotated by the regulating wheel and ground by the grinding wheel, supporting the work in tilted position with its longitudinal axis inclined with respect to its line of movement between said wheels, and shifting the axis of rotation of the work as it is thus supported and thus acted upon by said wheels.

9. The herein described art of grinding which consists in feeding between grinding and regulating wheels a succession of articles of relatively short length and pressing against the rearmost article a member of substantially greater length having a face tilted with respect to the line of movement of the articles and fitting snugly against the rear face of the rearmost article.

10. The herein described art of grinding which consists in feeding between grinding and regulating wheels a succession of articles of relatively short length preceded by a member of substantially greater length having a rear face inclined with respect to the line of movement of the articles and fitting snugly against the forward face of the foremost article.

11. The herein described art of grinding which consists in feeding between grinding and regulating wheels a succession of articles of relatively short length, preceded by a member of substantially greater length than that of said articles and having a rear face inclined with respect to the line of movement of said articles and fitting snugly against the forward face of the foremost article, and followed by a second member of substantially greater length than that of said articles and having a forward face substantially parallel to the rear face of said forward member and fitting snugly against the rear face of the rearmost article.

12. The herein described art of grinding which consists in feeding between grinding and regulating wheels a succession of articles of relatively short length and pressing against the rearmost article a member of substantially greater length having a face tilted with respect to the line of movement of the articles and fitting snugly against the rear face of the rearmost article, and rotating said member about an axis substantially coincident with the line of movement of said articles.

13. The herein described art of grinding which consists in feeding between grinding and regulating wheels a succession of articles of relatively short length, preceded by a member of substantially greater length than that of said articles and having a rear face inclined with respect to the line of movement of said articles and fitting snugly against the forward face of the foremost article, and followed by a second member of substantially greater length than that of said articles and having a forward face sub-

stantially parallel to the rear face of said forward member and fitting snugly against the rear face of the rearmost article, and rotating said two members about an axis substantially coincident with the line of movement of said articles.

14. The herein described art of grinding the outer surface of work having round cross-section and varying diameter lengthwise thereof which consists in feeding the work through between grinding and regulating wheels and across the operative surfaces thereof to be rotated and ground thereby and with its axis of rotation inclined with respect to its path of movement.

In testimony whereof, I have signed my name to this specification this 15th day of January, 1925.

LEWIS R. HEIM.