Aug. 20, 1935. G. W. BINNS 2,012,078

ART OF GRINDING

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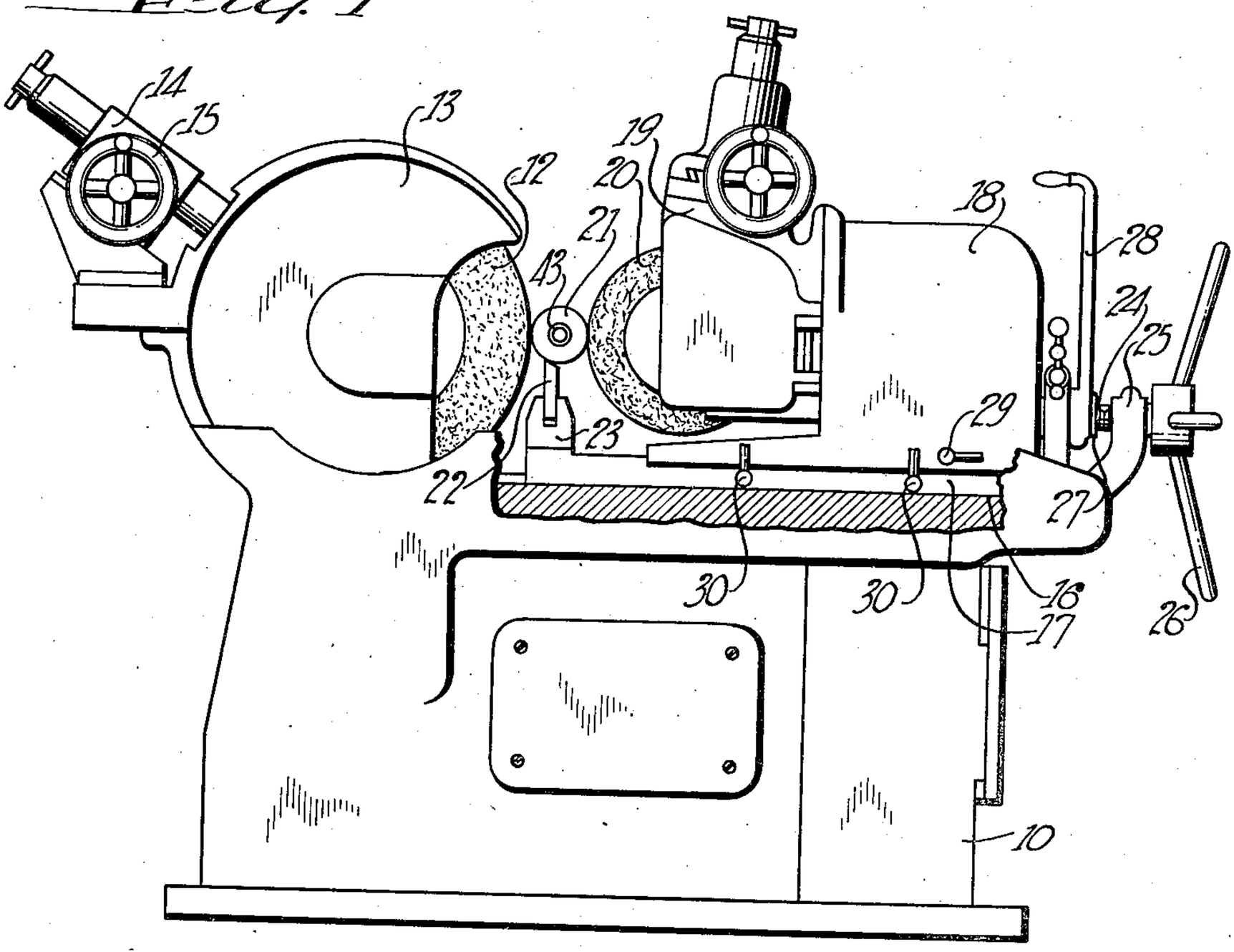
Fig. 1



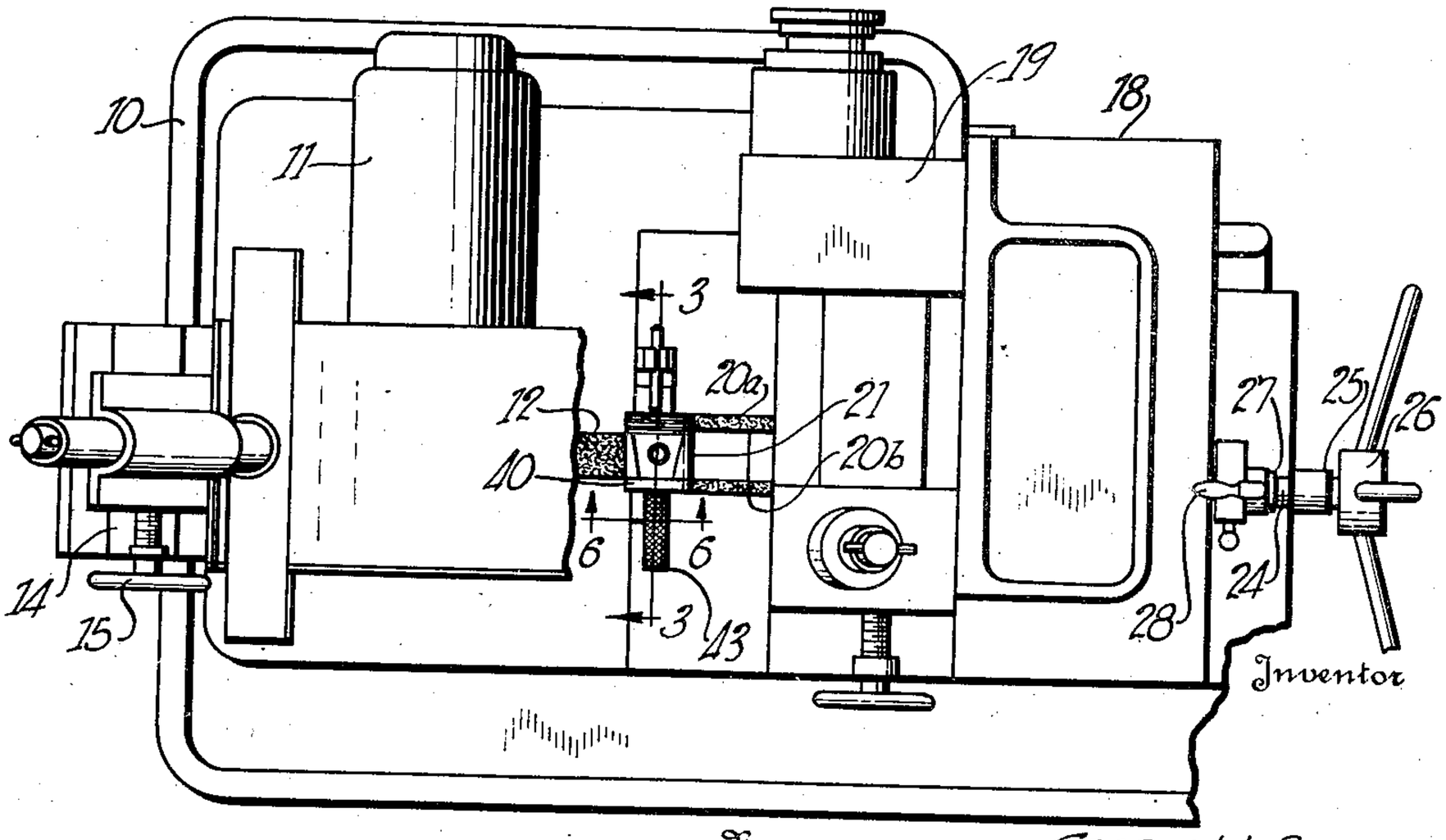


Fig. 2

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Fig. 3

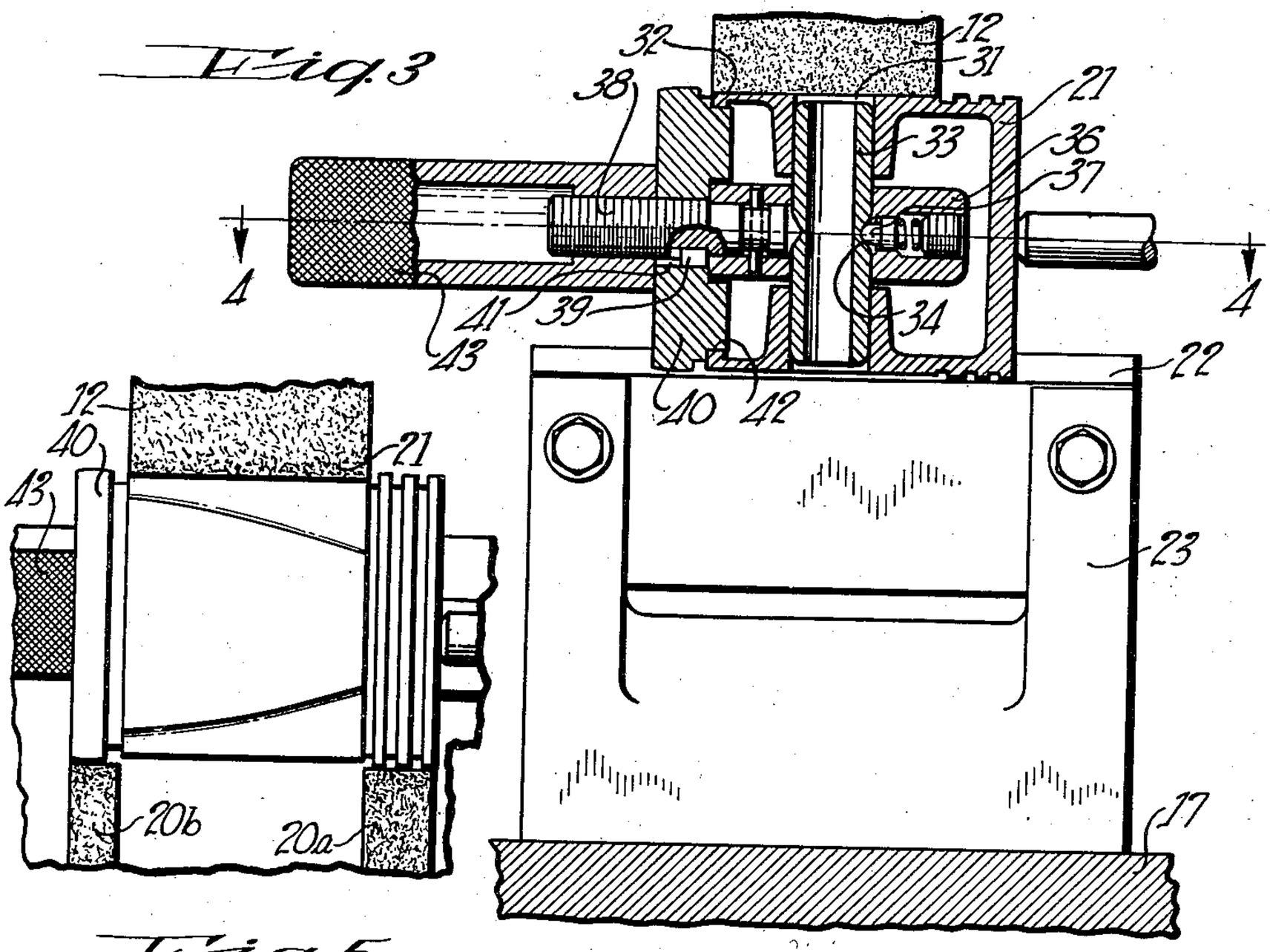

Fig. 5

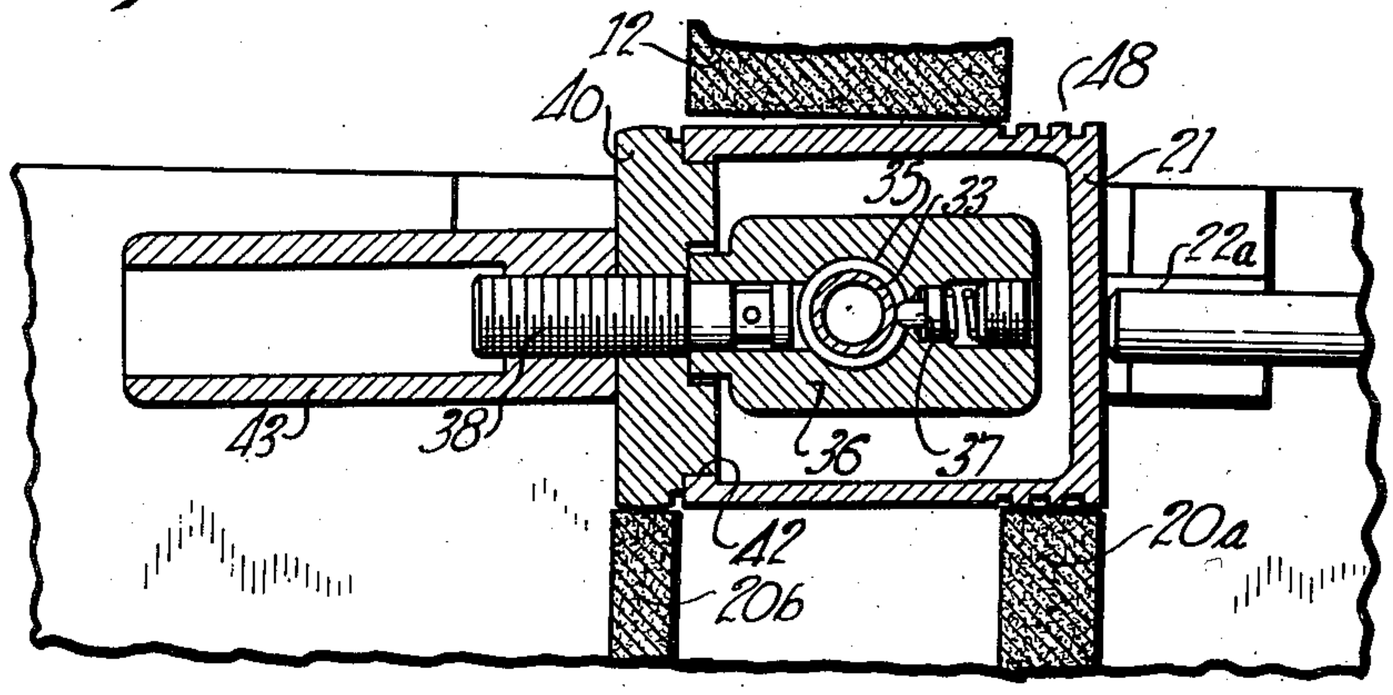

Fig. 4

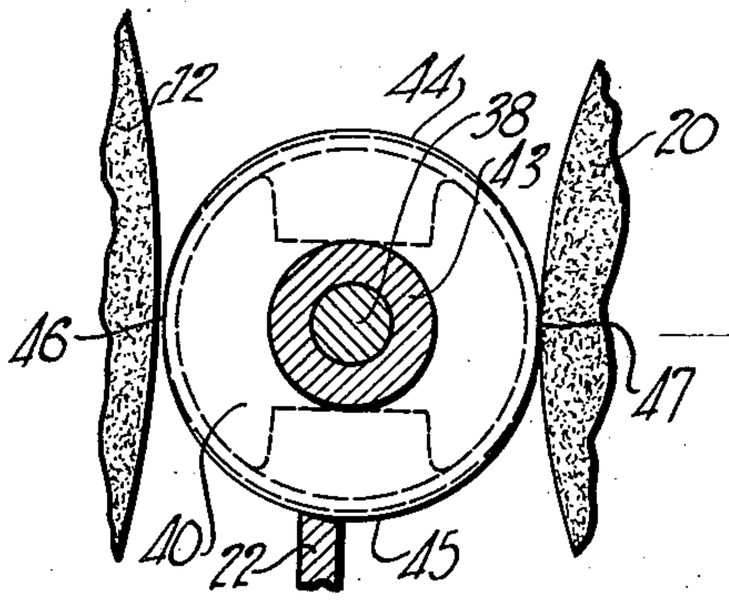

Fig. 6

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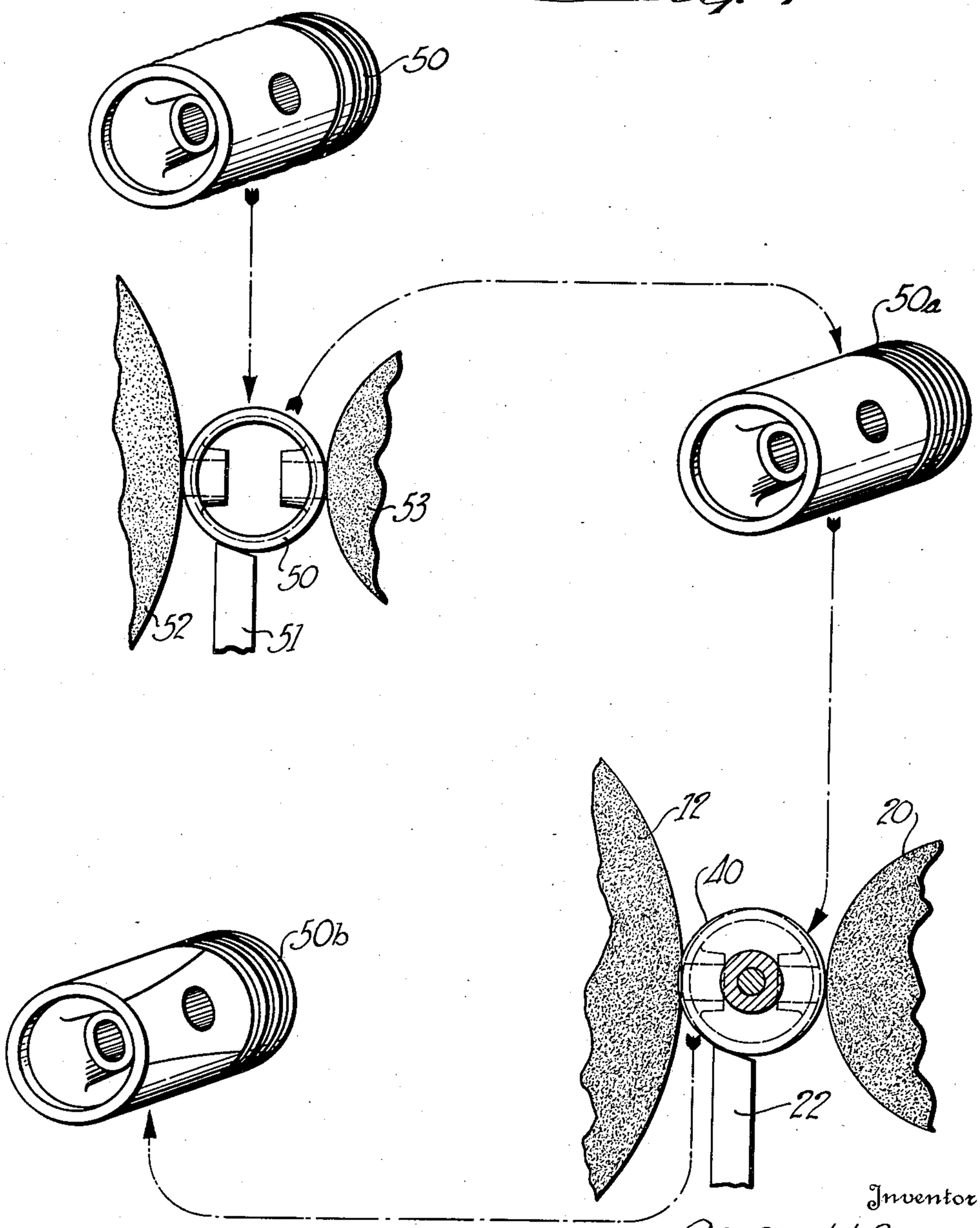
Fig. 7



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Patented Aug. 20, 1935 2,012,078

UNITED STATES PATENT OFFICE

2,012,078

ART OF GRINDING

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Application February 7, 1931, Serial No. 514,196

14 Claims. (Cl. 51—103)

This invention relates to improvements in the art of grinding and especially to improvements in the performance of grinding by the centerless method.

An object of the invention is the provision of improved means and an improved method for grinding parts by the centerless method which will be non-circular in cross section.

Another object of the invention is the provision of improved means for generating a non-cylindrical peripheral surface on a work piece.

A further object of the invention is the provision of improved means cooperating with the plane or non-formed grinding wheel face for effecting a controlled oscillating in and out movement of the work and grinding wheel in the plane in which their axes lie for generating a variably contoured non-cylindrical peripheral surface on the work.

A further and specific object of the invention is the provision of improved means for centerless grinding or finishing internal combustion engine pistons to a particular shape and contour to provide greater clearance between certain portions of the skirt than is provided at other portions thereof to compensate for the expansion of the piston during use.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in conjunction with the accompanying drawings and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

In the drawings:

Figure 1 is a front elevation of a centerless grinder embodying the principles of this invention.

Figure 2 is a top plan view of the device shown in Figure 1.

Figure 3 is a sectional view taken on line 3—3 of Figure 2.

Figure 4 is a fragmentary sectional view taken on line 4—4 of Figure 3.

Figure 5 is a fragmentary top plan view of certain parts of the throat of a centerless grinder illustrating the action of said parts.

Figure 6 is an enlarged fragmentary elevational view of certain parts forming the throat of the centerless grinder, as seen from line 6—6 of Figure 2.

Figure 7 is a diagrammatic illustration of the process for producing the improved piston or other formed work piece.

Throughout the several views of the drawings similar reference characters are employed to denote the same or similar parts.

As is noted above, this invention provides a structure whereby pistons for internal combustion engines may be rounded or finished to have greater clearance between certain portions of the skirt of the piston and the walls of the cylinder. It is to be understood, however, that the invention is broader in scope than the particular embodiment illustrated in the drawings and may be employed for grinding or finishing to other contours than that specifically illustrated if said contours are capable of being generated from a given master cam or form. The device is employed with a standard centerless grinder heretofore known and used.

Accordingly, the machine consists of a bed 10 having rising therefrom the bearings 11 for the grinding wheel spindle to which the grinding wheel 12 is secured. A guard 13 encloses the grinding wheel and forms a bearing or support for a truing mechanism 14 operable by means of the hand wheel 15 transversely of the face of the grinding wheel. The grinding wheel 12 is adapted to be rotated at a high grinding rate of speed in a clockwise direction. The bed 10 is further provided with ways 16 for a slide 17 capable of adjustment relative thereto toward and from the grinding wheel 12. A second slide 18 is supported upon the slide 17 and bears the housing or bracket 19 forming the bearings for the regulating wheels spindle supporting the regulating wheels 20 for rotation at a relatively slow work controlling rate of speed. The regulating wheels 20 rotate in a clockwise direction whereby the proximate points of the grinding-regulating wheels travel in opposite directions. The said proximate points of the grinding and regulating wheels are spaced from one another to form a grinding throat in which the work 21 is supported for action thereon by the said wheels. The work 21 is peripherally supported by a work rest blade 22 adjustably secured in a block 23 carried by the inner end of the slide 17. This work rest block 23 is also provided in its rear end with a work stop 22*a* which limits the axial movement of the work relative to the blade and grinding wheel.

The wheels 12 and 20 are actuated relative to one another by adjusting the slide 18 and regulating wheel 20 relative to the slide 17 for conditioning the grinding throat to the desired size. For this purpose there is provided an adjusting

screw 24 threadedly received in a nut 27 swiveled in the upper slide 18 on one end and rotatably journaled in a bracket or bearing 25 at its opposite end which bracket is carried by the bed 10. A pilot or hand wheel 26 is secured to the screw 24 exteriorly of the bracket 25 whereby the said screw is adjusted. To effect an enlargement of the grinding throat to permit replacement of finished work pieces therein the nut 27 has secured to it a manually operable in-feed lever 28 for oscillating said nut through a given arc thereby effecting a definite movement of the work 21, its support 22 and the regulating wheel 20 through a definite zone. In order that the upper and lower slides may move as a unit while feeding the work into the wheel there is provided a clamp 29 for securing said slides to one another while for effecting an adjustment of the slides relative to one another clamps 30 are provided for locking the slide 17 to the bed.

By reference to Figure 3 it will be noted that the work piece illustrated in the drawings is in the nature of a piston for internal combustion engines having the usual bore 31 extending transversely thereof for the piston pin. The lower end of the piston 21 is open and is provided with a finished face 32. A clamp stud in the nature of a piston pin 33 extends through the piston pin bore 31 and the said pin 33 is provided with a circumferential groove 34. The pin 33 also extends through a bore 35 formed in clamp bar 36. The clamp bar 36 carries a spring pressed plunger 37 seated in the groove 34 for locking the locking pin 32 relative to the piston 21. A threaded tang 38 extends from the bar 36 and has extending from it a key 39 extending at right angles to the axis of the bore 35 in the bar 36. A cam 40 surrounds the threaded tang 38 and has a keyway 41 therein for the key 39. The cam 40 is provided with shoulders 42 for engaging the finished end and inner face 32 of the work 30. A knurled handle or locking nut 43 is received on the threaded tang 38 and clamps the cam in the end of the piston 21 having a definite relation between the axis of the pin 33 and the finished shoulder 42 of the cam.

As seen in Figure 6, the cam 40 is elliptical in shape having the portions 44 and 45 extending in the direction of the major axis which lie outside of the periphery of the piston 21 while the portions 46 and 47 extending in the direction of the minor axis of the cam are coincident with the sides of the piston 21 at these points.

Figures 4 and 5 show the parts forming the grinding throat respectively, in section and plan where it will be noted that the regulating wheel 20 contacts with the work assembly only at two points, namely: the land portion 48 or that portion receiving the piston ring and with the cam 40, being relieved intermediate these portions. On the other hand, the grinding wheel is shown as capable of engaging the piston 21 between the land portion 48 and the cam 40 so that neither the cam 40 nor the land portion 48 will be ground or formed by the grinding wheel while the portion therebetween will be properly machined. The land portion 48 in contacting with the work rest blade 22 and regulating wheel 20*a* determines the axis of rotation of the work and the cam 40 contacting with the work rest blade 22 and regulating wheel 20*b* determines the rotation or gyratory movement of the axis so that a work piece having a periphery other than circular is produced. In other words, as the work cam is rotated by the regulating wheel the said wheels being of an unyielding nature will, upon engagement with the enlarged portions 44 and 45 of the cam, shift the end of the work, to which the cam is attached, toward the grinding wheel and when the smaller portions 46 and 47 of the cam align with the regulating wheel the work will fall away from the grinding wheel toward the regulating wheel and will clear the said grinding wheel. Since the said enlarged portions 44 and 45 of the cam are aligned with the sides of the piston through which the piston pin holes extend these sides of the piston will be deformed as compared to the remainder thereof.

In the particular embodiment shown in the drawings the regulating wheels 20*a* and 20*b* are of slightly different diameters, the latter being smaller than the former by an amount equal to the throw of the cam. By this construction when the high point of the cam is in engagement with the regulating wheel 20*b* the axis of the work will be parallel with the axis of the grinding wheel and regulating wheels while when the low point of the cam contacts with the wheel 20*b* the axis of the work is oblique to the axis of the wheels. Therefore, the upper portion of the skirt of the piston or the portion adjacent the lands, will be in contact with the grinding wheel a greater length of time than the other end of the piston but the depth of cut at the sides of the piston through which the piston pin holes are formed will be equal throughout the length thereof and gradually taper to the normal diameter of the piston. It is to be understood that the undercut portion of the piston need not necessarily be formed in the sides of the piston through which the piston pin holes extend but may be formed anywhere else it being only essential that the cam 40 be secured to the piston in the desired relationship thereto.

The showing in the drawings and the description here indicated that the regulating wheels 20*a* and 20*b* are of unequal diameters but these wheels may be made of the same diameter and the difference made up on the cam and the same result on the work obtained.

It is to be understood that any other type of work piece may be formed other than that specifically shown in the drawings and described in the specification so long as the said desired form is controlled by or to be duplicated from a master cam secured to the work.

The process for producing contoured work, such as an internal combustion engine piston, above described, is disclosed in Figure 7. The work piece 50 has been rough turned or initially formed by any suitable or desirable mechanism, such as a lathe, in which condition it is passed to a standard grinding machine for reduction to the desired cylindrical form. As shown in this figure the work 50 is placed on the work rest blade 51 of a standard centerless grinder which, in addition, comprises the grinding wheel 52 and regulating wheel 53 respectively rotated at proper speeds for effecting a stock removal from the work and controlling its rotation. The work piece now illustrated at 50*a* has been reduced to cylindrical form within very close limits having a smooth grinding finish suitable for use in a smooth walled cylinder. The piston has now secured thereto, as above described, the cam or contour controlling member 40 for generating the desired contour on the work. As shown, the work is again placed between opposed grinding and regulating wheels of a centerless grinder, such as 12 and 20 for reducing the said work

piece to the contour as determined by the cam **40**. At the conclusion of this grinding operation the work piece has the contour illustrated in Figure 7 at **50***b* or as shown in Figure 5.

From the foregoing it is believed that the complete manufacturing process and apparatus for producing non-circular work pieces by the centerless method will be thoroughly understood.

What is claimed is:

1. In a centerless grinder for producing articles of non-circular cross section the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade within the throat supporting the work in simultaneous engagement with the grinding and regulating wheels, and means carried by the work engaging the regulating wheel for effecting a relative in and out movement between the work and grinding wheel.

2. In a centerless grinder for producing articles of non-circular cross section the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade within the throat supporting the work in simultaneous engagement with the grinding and regulating wheels, means carried by the work engaging the regulating wheel for effecting a relative in and out movement between the work and grinding wheel, and additional means for actuating the work, regulating wheel and work rest blade as a unit toward and from the grinding wheel to operatively relate the work and grinding wheel.

3. In a centerless grinder the combination of a work rest blade, a grinding wheel on one side of the blade operable at a high grinding rate of speed, a pair of regulating wheels on the other side of the work rest blade flanking the extremities of the grinding wheel and operable at a relatively slow work controlling rate of speed, and means carried by the work for contacting with one of said wheels for effecting a gyratory movement of the axis of the work about a point determined by the other regulating wheel.

4. In a centerless grinder the combination of a bed, a grinding wheel carried thereby rotatable at a high grinding rate of speed, a slide on the bed for movement toward and from the grinding wheel, a regulating wheel rotatably supported by the slide movable at a relatively slow work controlling rate of speed, means for actuating the slide toward the grinding wheel, a work rest blade within the grinding throat formed between the opposed active faces of the grinding and regulating wheels, the work rest blade and regulating wheel forming a work receiving trough for supporting the work during the movement of the slide toward the grinding wheel, and additional templet means secured to the work for effecting in and out movement between the work and grinding wheel independent of the relative movement thereof by the slide actuating means.

5. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade within the grinding throat peripherally supporting a work piece, means carried by the work for engagement with the regulating wheel to effect an in and out movement between the grinding wheel and work, and means for securing the last mentioned means and work to one another in a predetermined relation.

6. A contour controlling templet mechanism for attachment to an article on which it is desired to form an irregular shape comprising an anchoring pin carried by the article, an attachment plate engaging the anchoring pin, a templet of the desired contour associated with the attachment plate, and means for locking the templet and article to one another through the anchoring pin and attachment plate.

7. A contour controlling templet mechanism for attachment to an article on which it is desired to form an irregular shape comprising an anchoring pin carried by the article, an attachment plate engaging the anchoring pin, a templet of the desired contour associated with the attachment plate, means for locking the templet and article to one another through the anchoring pin and attachment plate, and means for aligning the templet and work in predetermined relationship.

8. In a grinding machine the combination of a grinding wheel, a work rest blade adjacent the grinding wheel for peripherally supporting a work piece for floating movement toward and from the grinding wheel, means on the other side of the work rest blade for frictionally engaging and controlling the rotation of the work piece, and means carried by the work for engagement with the said rotation controlling means for effecting an oscillation of the axis of the work toward and from the surface of the grinding wheel.

9. In a grinding machine of the class described for producing a work piece having a non-circular cross section, the combination of a grinding wheel, a regulating wheel, the proximate points of said wheels being spaced from one another to form a grinding throat therebetween, a work rest blade within said grinding throat for supporting a work piece in simultaneous engagement with the grinding and regulating wheels, the work rest blade and regulating wheel determining the plane of the axis of rotation of the work, and means carried by the work for effecting an oscillating movement of the axis of rotation of said work in said plane toward and from the surface of the grinding wheel.

10. In a device for undercutting a portion of the skirt of an internal combustion engine piston the combination with a centerless grinder comprising a pair of opposed grinding and regulating wheels forming a grinding throat therebetween and a work rest blade within said throat for peripherally supporting the piston, of means carried by the piston for effecting an oscillation of the surfaces of the work and grinding wheel toward and from one another.

11. In a device for undercutting a portion of the skirt of an internal combustion engine piston the combination with a centerless grinder comprising a pair of opposed grinding and regulating wheels forming a grinding throat therebetween and a work rest blade within said throat for peripherally supporting the piston, of means carried by the piston for effecting an oscillation of the surfaces of the work and grinding wheel toward and from one another, said means comprising an anchoring pin extending through the normal piston pin holes formed in the piston, a templet having the desired contour for undercutting the piston, and means for securing the anchoring pin, templet and piston to one another as a unit.

12. In a device for undercutting a portion of the skirt of an internal combustion engine piston the combination with a centerless grinder comprising a pair of opposed grinding and regulating wheels forming a grinding throat therebetween

and a work rest blade within said throat for peripherally supporting the piston, of means carried by the piston for effecting an oscillation of the surfaces of the work and grinding wheel toward and from one another, said means comprising an anchoring pin extending through the normal piston pin holes formed in the piston, a templet having the desired contour for undercutting the piston, means for securing the anchoring pin, templet and piston to one another as a unit, and additional means for determining the relative position of the templet and piston to one another.

13. The process of producing undercut portions on a piston to compensate for expansion when in use consisting in grinding a cylindrical piston in a centerless grinder and effecting a controlled variation in the angular relationship of the piston axis and grinding wheel per revolution of the piston whereby an ultimate deformed non-cylindrical portion is produced on said piston.

14. The process of producing non-cylindrical work pieces consisting in initially introducing the work into the throat of a centerless grinder to reduce same to cylindrical form, securing thereto a formed templet, and subsequently introducing the work with the templet attached into the throat of a centerless grinder with the templet contacting the regulating wheel to effect a controlled relative oscillation of the axes of the grinding wheel and work.

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