July 2, 1940. H. S. INDGE 2,206,842

ABRADING MACHINE

Filed May 13, 1937 2 Sheets-Sheet 1

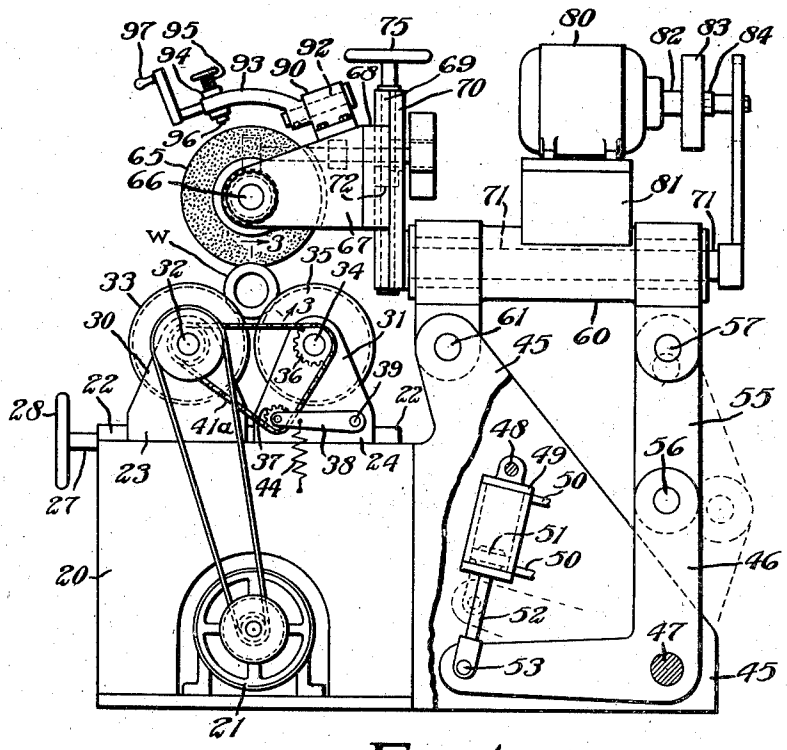

Fig. 1

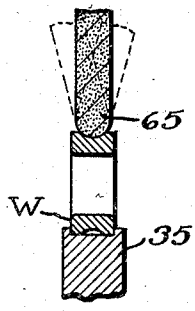

Fig. 3

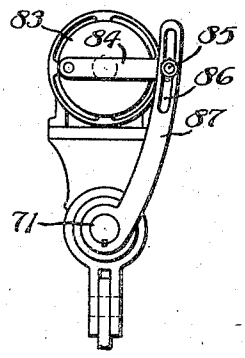

Fig. 2

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ABRADING MACHINE

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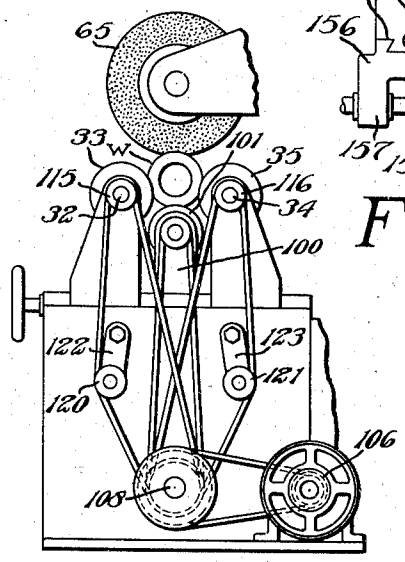

Fig. 5

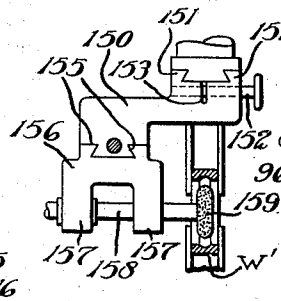

Fig. 8

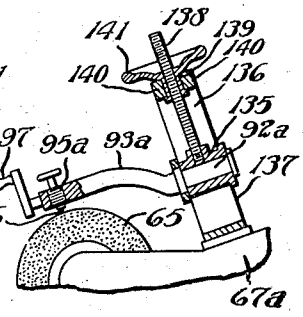

Fig. 7

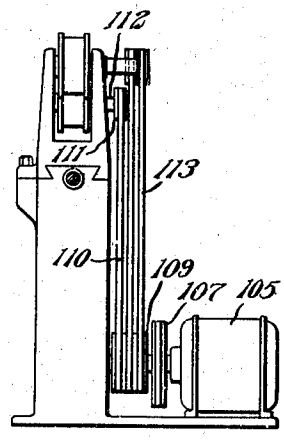

Fig. 6

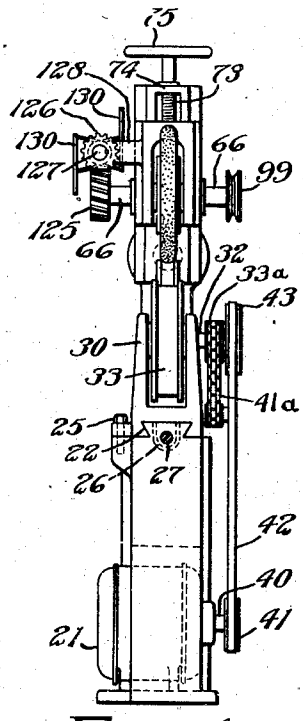

Fig. 4

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UNITED STATES PATENT OFFICE

2,206,842

ABRADING MACHINE

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Application May 13, 1937, Serial No. 142,343

5 Claims. (Cl. 51—33)

The invention relates to abrading machines and, with regard to its more specific features, to a lapping machine.

One object of the invention is to provide an efficient lapping machine for lapping the races of ball bearings. Another object of the invention is to provide a machine of the type indicated of high productive capacity. Another object of the invention is to provide a machine adapted to impart a smooth polished surface to a work piece and capable of dependable operation in practical use. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangements of parts, as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings showing some of many possible embodiments of the mechanical features of the invention,

Figure 1 is a side elevation of a lapping machine constructed in accordance with the invention;

Figure 2 is a fragmentary rear elevation of the machine, showing the mechanism for oscillating the upper wheel head;

Figure 3 is an enlarged fragmentary cross sectional view on the line 3—3 of Figure 1;

Figure 4 is a front elevation of the machine;

Figure 5 is a side elevation similar to Figure 1, showing a modification of the invention;

Figure 6 is a front elevation of the modification of Figure 5;

Figure 7 is a side elevation of a modified form of dressing device;

Figure 8 is a view, partly in plan and partly in horizontal section, of a modification whereby an internal race may be lapped.

Referring first to Figure 1, I provide a base 20 housing a driving motor 21. As better shown in Figure 4, on the upper part of the base 20 are dovetailed ways 22. Referring now to Figure 1, mounted upon the ways 22 are a pair of slides 23 and 24 having formed therein ways complementary to the dovetailed ways 22. One of these slides 23 and 24 is adjustably secured in position upon the ways 22, as by means of a tightening bolt 25. Preferably, this is the slide 23. The other slide, preferably the slide 24, has, as shown in Fig. 4, a nut 26 depending therefrom through which passes a screw shaft 27 suitably journaled in the base 20 and having on the front thereof a hand wheel 28. Thus the slide 24 may be quickly adjusted fore and aft of the machine.

On the upper side of the slide 23 is a fork 30 which is clearly shown in Figure 4. Journaled in the fork by means of a shaft 32 is a wheel 33. On the upper side of the slide 24 is a similar fork 31. Journaled in the fork 31 by means of a shaft 34 is a wheel 35. The shape of each of these wheels, as shown in Figure 4, is that of a grooved pulley.

The wheels 33 and 35 are rotated in the same angular direction and at the same peripheral velocity by the motor 21. A work piece W fits in the grooves of the wheels 33 and 35 and is rotated by them. As shown, the workpiece W is a ball race. The work piece W is thus held in a fixed position and rotated and the toric ball receiving surface is then lapped by a mechanism which will be described.

Considering now the means for rotating the wheels 33 and 35, and referring to Figures 1 and 4, mounted on the motor shaft 40 of the motor 21 is a pulley 41 which is connected by means of a belt 42 with a pulley 43 secured to the shaft 32 for the wheel 33. Also secured to the shaft 32 is a sprocket 33*a*. Secured to the shaft 34 is another sprocket 36. A third sprocket 37 is mounted on an arm 38 which is pivotally mounted at 39 on the slide 24. A spring 44 pulls the arm downward. A sprocket chain 41*a* passes around all of the sprockets 33*a*, 36 and 37, the chain being kept tight under varying adjustments of the slide by means of idler sprocket 37. Thus are the wheels 33 and 35 driven at the same rate of speed and in the same angular direction.

Referring now to Figure 1, extending rearwardly from the base 20 are parallel spaced walls 45, 45 between which is located a bell crank lever 46 mounted on a trunnion 47 journaled in the walls 45, 45. Between the walls 45, 45 and pivotally connected thereto by means of a shaft 48 is a cylinder 49 connected by pipes 50, 50 to a suitable valve, not shown, connected to a suitable source of fluid under pressure and exhaust. The usual four-way hand valve and a source of air under pressure bay be used. In the cylinder 49 is a piston 51 whose piston rod 52 is connected at 53 to one end of the bell crank lever 46.

A link 55 is connected at 56 to the bell crank lever 46 and at 57 to a support 60 which is pivotally mounted on a shaft 61 extending between the walls 45, 45. The bell crank 46 and link 55 thus constitute a toggle to move the support 60. When the piston 51 is up, the bell crank 46 is

in the dotted line position shown in Figure 1 and the toggle is broken. This draws downwardly the rear portion of the support **60** and swings upwardly a lapping wheel **65** which is supported by the support **60** in position to contact the work piece W which is held and rotated by the wheels **33** and **35**. When the piston **51** is moved downwardly in the cylinder **49**, the bell crank lever **46** is moved to the full line position of Figure 1, thus lowering the wheel **65**.

Referring now to Figures 1 and 4, the wheel **65** is mounted upon a shaft **66** extending between and journaled in the side plates for a forked support **67** constituting an integral part of a vertical slide **68** which is mounted upon dovetailed ways **69** of a column **70** attached to the front of a shaft **71** journaled in the support **60**. Attached to the slide **68** is a nut **72** through which passes a screw shaft **73** journaled at **74** in the column **70**. A hand wheel **75** attached to the screw shaft **73** may be used to turn it, thereby raising and lowering the slide **68** and with it the fork **67** and, therefore, the lapping wheel **65**. The wheel **65** is a toric wheel and may be formed of any suitable abrasive material, such as silicon carbide or aluminum oxide bonded with any suitable bond such as vitrified ceramic, or resinoid, or natural resin, or rubber or any other known type. The wheel **65** is adjusted up and down on the column **70** in order that it may be placed in such a position that the axis extended of the shaft **71** shall be tangent to the toric center circle of the wheel **65**. The shaft **71** is oscillated about its axis and thus the wheel **65** will lap a toric surface upon the work piece W.

Considering now the mechanism for oscillating the shaft **71** and thus oscillating the toric surface of the wheel **65** about a line tangent to its toric circle, I provide, as shown in Figure 1, a motor **80** mounted upon a stand **81** fixed to the support **60**. Mounted on the armature shaft **82** of the motor **80** is a fly wheel plate **83** having fastened thereto an arm **84**. As better shown in Figure 2, the arm **84** has a stud **85** on one end thereof which passes through an arcuate slot **86** in an arm **87** fastened to the shaft **71**. When the motor **80** is energized, the arm **87** is oscillated and this oscillates the shaft **71**.

I provide means for truing the wheel **65** from time to time, giving it a true toric surface. As shown in Figure 1, I provide a bracket **90** removably to the sides of the fork **67** which supports a stud shaft **92** upon which is pivotally mounted an arm **93** supporting a sleeve **94** which is internally threaded and receives a threaded diamond holder **95** supporting a dressing diamond **96**. The arm **93** has a handle **97** whereby it may be oscillated. To change the toric radius, the threaded diamond holder **95** is moved up or down in the sleeve **94**. To dress the wheel after it has been worn, that is, reduced in diameter through wear, a new bracket **90** is provided. I may provide a series of brackets **90** of slightly different size for the dressing of the wheel **65** in different sizes thereof.

Referring to Figure 4, in order to rotate the wheel **65** for dressing purposes, a long belt, not shown, may be used to connect the pulley **41** with a pulley **99** fastened to the wheel shaft **66** of the wheel **65**.

A modification of the invention is shown in Figures 5 and 6 wherein an intermediate slide **100** is provided, mounted upon the ways **22**, which slide **100** journals a wheel **101** similar to the wheels **33** and **35**. This wheel **101** supports the downward pressure of the wheel **65**. This construction is preferably used in the case of small work pieces or in any case where the lines of tangency between the work piece W and the wheels **33** and **35** are such that there would be danger of deforming the work piece W from its circular condition due to wedging action of the wheels **33** and **35**. The drive for the several wheels is illustrated in Figures 5 and 6 and as therein shown, a motor **105** has a pulley **106** driving a pulley **107** mounted on a shaft **108** journaled in the machine frame. A large pulley **109** secured to the shaft **108** has three V grooves, around one of which passes a belt **110** driving a pulley **111** fastened to the shaft **112** which supports the wheel **101**. A continuous belt **113** passes around pulleys **115** and **116** secured to the shafts **32** and **34** that support the wheels **33** and **35**. The belt **113** also passes twice over the pulley **109** and around idler pulleys **120** and **121** journaled in brackets **122** and **123** adjustably bolted to the machine frame, as shown in Figure 5.

The wheels **33** and **35** and **101** in all modifications of the invention may be made of steel or they may be made of abrasive material of any type, if desired. The action is a lapping action in which the work piece is rotated at a moderate speed in contact with the abrasive wheel **65** which has a toric surface and which is being oscillated about a line tangent to the toric center, as stated. The wheel **65** is preferably not positively rotated but is allowed to drag on the toric surface of the work piece. To that end, as shown in Figure 4, the shaft **66** of the wheel **65** has fixed thereto a helical gear **125** meshing with another helical gear **126** which is fixed to a shaft **127** journaled in a bracket **128** fastened to the forked support **67**. As shown in Figures 1 and 4, on the rear end of the shaft **127** is mounted a fan **130**, for example having blades of the type used as governors for spring actuated machinery, such as music boxes and the like. This fan **130** acts as a regulator to prevent the wheel **65** from attaining the speed of the work piece. Any other type of regulator, such as that used in phonographs, may be substituted, or a plain friction brake might be employed.

By means of the actuating cylinder **49**, the wheel **65** can be quickly raised so that a work piece may be introduced into the machine. The wheel may be as quickly lowered into position and the lapping operation is not only effective but quickly performed by the dragging action of the oscillating wheel **65**. Relative motion between the work piece and the wheel **65** is not uniform but irregular and produces a true lapping action. Figure 3 illustrates in dotted lines the oscillating action of the wheel **65** relative to the work piece W.

Referring now to Figure 7, I have illustrated a modification of the dressing device which may be readily adjusted for wheel wear. As shown therein, a dressing arm **93***a* supports a threaded diamond holder **95***a* having a diamond **96** which is oscillated in contact with the wheel **65** to produce the toric surface thereof. The arm **93***a* has an operating handle **97** as in the other embodiment of the invention. The arm **93***a* has a spindle portion **92***a* journalled in a slide **135** which fits between parallel guides **136** of a supporting bracket **137** that may be attached to the forked support **67***a*. A screw shaft **138** is attached to the slide **135** and passes through a nut **139** which has a thimble portion gripped by a pair of half journal members **140**, **140** extend-

ing between and fastened to the parallel guides 136. A hand wheel 141 integral with or attached to the nut 139 facilitates the turning of the nut 139 to adjust the center of oscillation of the diamond 96 radially of the wheel 65.

Referring now to Figure 8, I have therein illustrated an attachment which may be provided for the lapping of the internal surfaces of the external races of ball bearings. This attachment comprises a bracket 150 having a dovetailed portion 151 fitting the slideways 69. This bracket 150 may be clamped in place on the slideway 69 by means of a tightening screw 152 passing through a slotted dovetailed portion 153 of the bracket 150. Bracket 150 is a double angle in plan view and on the front thereof are slideways 155 supporting a slide 156 having forked extensions 157, 157 journalling a shaft 158 upon which is mounted a toric lapping wheel 159 which is small enough to fit inside of a work piece W' to lap an internal raceway thereof. The shaft 158 is also preferably restrained from spinning in any suitable manner, as for example by the mechanism shown in Figure 4 and previously described. Similarly, the slide 156 may be adjusted vertically in the same manner in which the slide 67 is adjusted vertically.

A metallic toric wheel or lap, charged with suitable abrasive, may be substituted for the bonded abrasive lap or toric wheel.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In apparatus of the class described, the combination with a pair of wheels mounted on parallel axes, and means to rotate them in the same angular direction, of a toric lapping wheel mounted on an axis parallel to the axes of said pair of wheels, means to retard the rotation of said toric wheel, and means to oscillate said toric wheel about an axis which is tangent to the toric circle.

2. In apparatus as claimed in claim 1, the combination with the parts and features therein specified, of means for adjusting the toric wheel in a direction transverse to its axis of oscillation.

3. In apparatus of the class described, a pair of wheels mounted on parallel axes, means to rotate one of said wheels, a toric lapping wheel mounted opposite said pair, means to oscillate said toric lapping wheel about an axis tangent to the work circle, and means to restrain the rotation of the toric lapping wheel, whereby a work piece held by the pair of wheels will be rotated in contact with the toric lapping wheel and lapped thereby.

4. In apparatus of the class described, a machine base, a slide, a wheel mounted on said slide, a second slide, a wheel mounted on second slide parallel to said first slide, the movement of the slides being transverse to the axis of the wheels, an abrasive wheel, means to oscillate the abrasive wheel on an axis perpendicular to its geometrical axis, and toggle means to raise and lower the abrasive wheel.

5. In appraratus of the class described, a base, a pair of work supporting and rotating wheels mounted on said base, means to adjust the wheels toward and from each other, means to rotate one of the wheels, a rock shaft, means to oscillate the rock shaft, a slide mounted on the rock shaft movable toward and from the center of oscillation, a fork carried by the slide, an abrasive wheel mounted in the fork whereby adjustment of the slide adjusts the periphery of the wheel toward and from the axis of oscillation, a support for the rock shaft, a pivotal mounting for the support, and a toggle mechanism to move the rock shaft as a unit and not about its axis to bring the abrasive wheel into and out of engagement with the work piece held by the said pair of wheels mounted on the base.

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