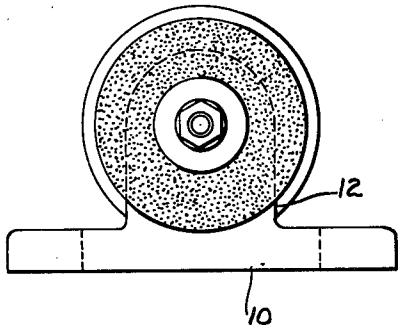
Nov. 7, 1950 C. E. SWEETSER 2,528,621

GRINDING WHEEL TRUING APPARATUS

Filed July 11, 1947

Fig. 1



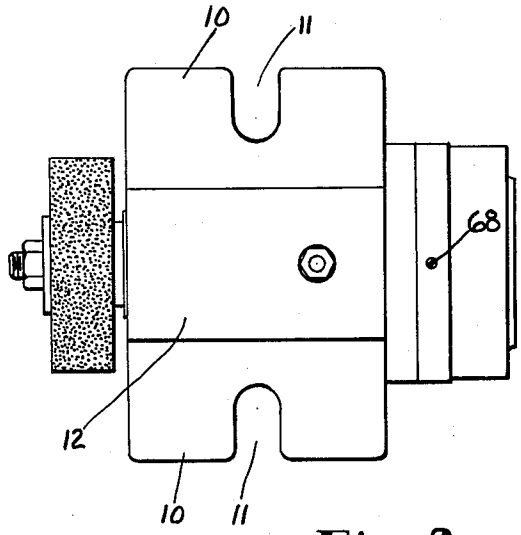


Fig. 2

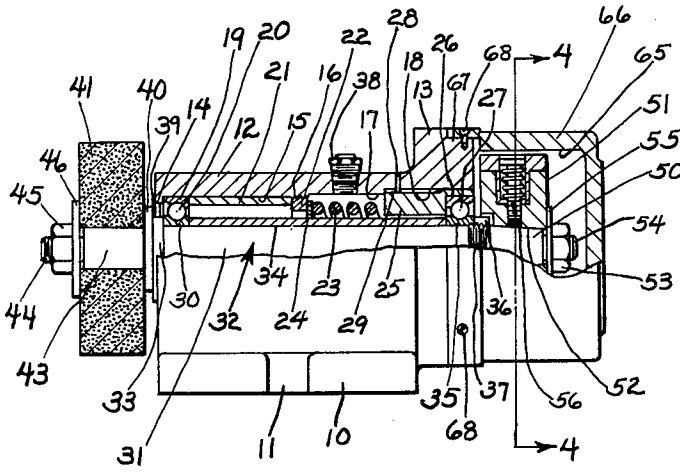


Fig. 3

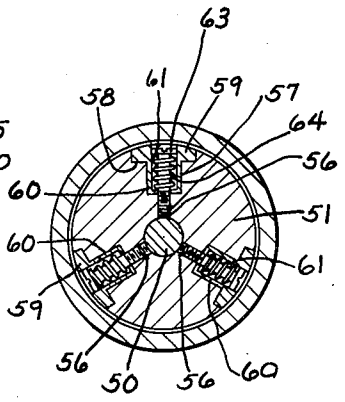


Fig. 4

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Patented Nov. 7, 1950 2,528,621

UNITED STATES PATENT OFFICE

2,528,621

GRINDING WHEEL TRUING APPARATUS

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Application July 11, 1947, Serial No. 760,366

4 Claims. (Cl. 51—134.5)

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The invention relates to apparatus for truing grinding wheels, especially for truing diamond grinding wheels and of these especially for truing diamond grinding wheels bonded with the harder bonds such as with metal bond or vitrified ceramic bond.

One object of the invention is to provide a simple and dependable apparatus which can be used on a wide variety of grinders for truing the grinding wheel thereof. Another object is to provide a truing tool for diamond grinding wheels which will shape them accurately. Another object is to provide a tool of the character indicated which is capable of truing the hardest of grinding wheels. Another object of the invention is to provide a truing tool of the character indicated whose wearable part is relatively inexpensive and easily replaced. Another object of the invention is to provide a rotary truing tool with an effective control to enable it to perform a truing operation on very hard grinding wheels accurately. Another object of the invention is to provide a truing tool to true grinding wheels, especially diamond grinding wheels, which is resistant to wear.

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, all 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 in which is illustrated one of various possible embodiments of the mechanical features of this invention,

Figure 1 is an end elevation of truing apparatus constructed in accordance with the invention,

Figure 2 is a plan view of the apparatus of Figure 1,

Figure 3 is a view, partly in side elevation and partly in axial section, of the apparatus,

Figure 4 is a cross-sectional view taken on the line 4—4 of Figure 3.

Referring to Figures 1, 2 and 3 the apparatus has a base 10 which is shown as a flat piece of metal, rectangular in plan, and which has slots 11, one on each side, whereby the base 10 can be clamped to the table or other part of the grinder, as by means of bolts not shown. The base 10 is integral with an upstanding housing 12 which has at one end a flange 13. The base 10, the housing 12 and the flange 13 may be one piece of metal, for example a piece of cast iron.

The housing 12 is bored all the way through to form a series of coaxial bores the axis of which

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is parallel to the bottom of the base 10. As shown in Figure 3 and working from left to right there is first an integral inwardly extending flange 14, then a long bore 15, next internal screw threads 16, then a bore 17 of larger diameter than that of the bore 15 and finally a bore 18 of larger diameter than the bore 17. In contact with the flange 14 is the outer race 19 of a ball bearing 20 which race is pressed against the flange 14 by a sleeve 21 which closely fits the bore 15 and which is engaged by a ring nut 22 whose threaded exterior is in engagement with the internal screw threads 16. In the bore 17 is a spring 23 which at the left hand end engages a washer 24 in contact with the ring nut 22 and which spring 23 at the right hand end engages a sleeve 25 in the bore 18, the right hand end of the sleeve 25 being cut away to receive the outer race 26 of a ball bearing 27. The sleeve 25 is slidable in the bore 18 but is prevented from turning therein by means of a pin 28 through the housing 12 which pin 28 engages a slot 29 in the sleeve 25.

The ball bearing 20 has an inner race 30 which nicely fits a long cylindrical portion 31 of a spindle 32. The left hand side of the race 30 is in engagement with a flange 33 of the spindle 32, while the right hand side of the race 30 is engaged by a long sleeve 34 fitting the cylindrical portion 31. On the cylindrical portion 31 and engaging the right hand end of the long sleeve 34 is the inner race 35 of the ball bearing 27. A nut 36 screwed onto a threaded portion 37 of the spindle 32 engages the inner race 35 and by tightening the nut 36 the two races 30 and 35 are held tightly on the spindle 32 in fixed spaced relationship. It will now be seen that the foregoing provides a precision mounting for rotation of the spindle 32 in the housing 12 since all play is taken out of the ball bearings by the spring 23 which through the sleeve 25 thrusts the race 26 to the right thus thrusting the entire spindle 32 to the right to take out all play in the ball bearing 20 whose outer race 19 is rigidly held as described. The spindle 32 will thus run true and with little friction, due to the ball bearings, in the housing 12 and it is noted that the axis of the spindle 32 is parallel to the plane of the bottom of the base 10 and is perpendicular to the long sides of the rectangular shape of the base 10 and to a line drawn between the centers of the slots 11. Thus the spindle 32 may be accurately located on a precision machine having a slot for affixing T-bolts or equally well the base 10 can be held in position by a magnetic chuck and the spindle 32 thereby accurately and rigidly located. In

order to lubricate the ball bearings 20 and 27 there may be provided an oiling plug 38 screwed into the housing 12 and extending into the bore 17. The washer 24 slightly clears the sleeve 34 to allow the oil to work to the left while the clearance between the sleeve 25 and the sleeve 34 will allow the grease to work to the right. A felt washer, or the like, 39 is located between the flange 14 and the flange 33 to keep the oil from coming out of the bore in the housing 12.

Adjacent the flange 33 on the spindle 32 is a larger flange 40 which serves to hold the washer 39 in place and also positions a grinding wheel 41 which has the usual central hole and which fits on a cylindrical portion 43 of the spindle 32. The left hand end of the spindle 32 has a screw threaded portion 44 on which may be mounted a nut 45 engaging a washer 46 to clamp the grinding wheel 41 tightly against the flange 40.

Referring now to Figure 4 and the right hand side of Figure 3, I provide a centrifugal friction brake which will now be described. As shown in Figure 3 the spindle 32 has a tapered portion 50 on which fits a cylindrical metal member 51 having a tapered hole 52 to fit the tapered portion 50. The cylindrical member 51 is rigidly held on the spindle 32 by means of a nut 53 on the threaded end portion 54 of the spindle 32, the nut 53 engaging a washer 55 which is in engagement with the side of the cylindrical metal member 51.

A plurality of threaded bores 56 are formed in the cylindrical member 51 which bores are radial to the cylindrical member 51. These threaded bores 56 extend right into the tapered hole 52. They merge with larger unthreaded bores 57 which in turn merge into rectangular cut-outs 58 extending right across the periphery of the cylindrical metal member 51. In the cut-outs 58 are shoes 59 whose exterior surfaces are cylindrical segments forming a continuation of the cylindrical exterior surface of the member 51. The shoes 59 have cylindrical extensions 60 which fit in the bores 57. Countersunk in the shoes 59 and in the cylindrical extensions 60 are cylindrical holes 61 which do not extend clear through the inner ends of the cylindrical extensions 60. However, there are small holes in the inner ends of the extensions 60 through which pass screws 63 in engagement with the threads of the bores 56. In the cylindrical holes 61 and surrounding the screws 63 and extending between the inner ends of the extensions 60 and the heads of the screws 63 are springs 64.

When the grinding wheel 41 is rotated, it rotates the spindle 32 which rotates the cylindrical metal member 51. The shoes 59, which are preferably made of metal, have a certain mass and preferably they all have the same mass. Centrifugal force acts radially outward on the shoes 59 which, however, are restrained from moving by the force of the springs 64 which force can be adjusted by adjusting the screws 63. When the centrifugal force equals the spring force the shoes 59 are ready to move outwardly. A further slight increase in the centrifugal force due to increased angular velocity will move the shoes 59 slightly, whereupon the spring tension will automatically increase. I provide a cylindrical internal brake surface 65 which may be the interior of a cap 66 fitting over the cylindrical end 67 of the housing 12 and resting against the flange 13 and being secured in place by screws 68. Increase of angular velocity after the shoes 59 have started to move will finally bring them into contact with the surface 65 which will apply a friction to the apparatus to prevent further increase of angular velocity.

The apparatus in the cap 66 is a speed governor operating on the centrifugal force-friction principle. This particular governor will control the angular velocity of the grinding wheel 41 to within something better than 10% for most practical operations and this measure of control is satisfactory for truing diamond grinding wheels. Any other type of speed governor which will exercise similar control of the speed of the grinding wheel 41 may be used in place of the particular governor described. Many varieties of speed governors are now known to the art so therefore I need not describe any other type. It is desirable however that the governor employed permit easy starting of the tool and most governors will do so. It will be seen that when the grinding wheel 41 starts to rotate, there is no friction whatsoever produced by the governor until a speed close to the control speed is reached. This is true of the present governor and will be true of other governors where centrifugal force moves an element which finally becomes a friction element. I prefer such type of governors.

The apparatus of the present invention can be used on practically any kind of grinder, such as surface grinders, tool and cutter grinders, chip breaker grinders, carbide tool grinders, cylindrical grinders, centerless grinders, internal grinders and stone cutting machinery. It is sufficient to secure the base 10 to the appropriate part of the machine and then, using the precision feed, usually a cross feed, of the machine, feed the grinding wheel of the machine into the grinding wheel 41 of this apparatus. As aforesaid it is convenient to use a magnetic chuck, if such is available, to hold the base 10 in position. Otherwise bolts or clamps can be used. For different kinds and sizes of machines the base 10 may assume many different shapes in order to fit particular machines properly.

A wheel 41 having been selected which is itself true, and the base 10 having been secured in place on the grinder, at the desired angle, the diamond grinding wheel of any variety such as vitrified or metal or resinoid bonded is slowly fed into contact with the wheel 41. The wheel 41 due to the anti-friction bearings rapidly picks up speed until the governed speed is reached. Speeds of grinding wheels are usually stated in terms of peripheral velocity rather than angular velocity, because it is the peripheral or surface velocity which determines the cutting rate. Most diamond grinding wheels are driven at angular velocities which will produce surface speeds at between 4500 and 6500 surface feet per minute. A standard speed for a diamond grinding wheel is 5500 surface feet per minute, either peripheral velocity or the surface velocity of an annular face which does the grinding in the case of cup wheels. I have found that the truing wheel 41 should revolve at between 1000 and 2000 surface feet per minute for good results. I now prefer about 1500 surface feet per minute for the wheel 41 when the diamond wheel is moving at 5500 surface feet per minute. The governor in the cap 66 can readily be adjusted to give this velocity.

The grinding wheel 41 for best results should be a wheel made of silicon carbide abrasive bonded with vitrified bond. However it is to be understood that other abrasives could be used to make the wheel 41. I believe however that silicon car-

bide will give the best results on all kinds of diamond grinding wheels.

The grit size of the abrasive of the wheel **41** is determined by the grit size of the diamond abrasive in the wheel to be trued for the best results. For all diamond wheels having diamonds coarser than 60 grit size I prefer to use 30 grit size silicon carbide. For diamond grinding wheels having diamonds of grit size 60 to 80 I prefer to use 46 grit size silicon carbide. For diamond grinding wheels having diamonds of 100 to 180 grit size I prefer to use 60 grit size silicon carbide. For metal bonded and vitrified bonded diamond grinding wheels having diamonds of 220 grit size and finer, I prefer to use 80 grit size silicon carbide. The apparatus of the invention is useful for truing all types of metal bonded and vitrified bonded diamond grinding wheels of which I have knowledge and it is useful for truing resinoid bonded diamond grinding wheels up to 220 grit size.

With regard to the grade and structure of the grinding wheel **41**, I prefer medium structure and in most cases the grade hardness should be medium but this is dependent upon the extent of contact between the diamond wheel and the wheel **41** and upon the grit size of the diamond wheel. If the contact is narrow, that is below a quarter of an inch, harder grades of wheels **41** should be used. Also if the grit size of the diamond wheel is on the coarse side, the grade hardness of the wheel **41** should be increased and vice versa.

A few examples will now be given of specifications for the wheel **41** for corresponding specifications of the diamond wheels and it is understood that in all cases the diamond wheel surface is moving at 5500 surface feet per minute and the wheel **41** is governed to cause its peripheral surface to move at close to 1500 surface feet per minute.

For truing a so-called "straight" diamond wheel, that is to say comprising a cylindrical disc grinding on the periphery, of dimensions 8" in diameter by ½" thick, having 100 grit size diamonds bonded with vitrified bond with 25 volume per cent of diamonds, grade N, a silicon carbide wheel **41** of 60 grit size, grade L and structure **5** is preferred. For truing a cutting-off wheel consisting of a disc 12" in diameter and $\frac{3}{32}$ of an inch thick comprising 12½ volume per cent of 80 grit size diamonds bonded with grade N metal bond, I prefer a wheel **41** having 46 grit size silicon carbide bonded with vitrified bond to grade 0 and structure **5**.

In using the apparatus of the present invention the grinding wheel **41** is traversed across the face of the grinding wheel to be trued. The relative motion between the grinding wheel **41** and the diamond wheel is thus like the relative motion between a truing diamond and an ordinary grinding wheel. Since there are so many different kinds of grinders the foregoing will be made clear by reference to a surface grinder having a flat table and a grinding wheel spindle above the table parallel to it. If it is desired to true a "straight" cylindrical diamond wheel which grinds on the periphery on such a machine, the diamond wheel is secured to the spindle of the machine and the apparatus of this invention is secured to the table of the surface grinder with its spindle **32** parallel to and underneath the spindle which holds the diamond wheel. The down feed of the surface grinder is used to cause the wheels to approach. This is the infeed for the truing operation. The cross feed of the surface grinder will produce a traverse between the wheel **41** and the diamond wheel to be trued. The down feed is adjusted so that the two wheels will just make contact and then the cross feed is used to traverse. After one or two passes the down feed may be used to cause a further infeed between the wheels. In using this apparatus an infeed of one thousandth of an inch is a good infeed. Lesser infeeds can be used but in most cases the infeed between successive passes should not be much greater than a thousandth of an inch.

It is important for the life of the apparatus that grit be kept away from the ball bearings **20** and **27**. The washer **39** serves to some extent to keep the abrasive dust from getting inside of the housing **12**. Other means of sealing the housing **12** can be provided. Most of the operations performed so far have been done dry partly because of danger of getting lubricant loaded with abrasive into the bearings. Good results have been obtained in dry operations. However in certain cases it may be desired to use a grinding lubricant such as a soluble oil water mixture in performing the truing operation.

For the governor, good results have been had using shoes **59** made of bronze and a brake surface **65** of steel. The friction combination was therefore bronze against steel. This combination is resistant to wear and while it also makes a good bearing, the combination of large diameter and pressure causes sufficient friction to be developed to govern the speed satisfactorily. However other materials can be used for the friction elements.

It will thus be seen that there has been provided by this invention an 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. Truing apparatus for grinding wheels comprising a spindle having a portion upon which a truing grinding wheel can be mounted, a truing grinding wheel secured on said portion, said truing grinding wheel comprising crystalline abrasive in a vitrified bond, a housing, bearings in said housing journalling said spindle, a member connected to and on said spindle and mounted for rotation, brake shoes mounted on said member, springs operating against said brake shoes, and a brake drum surrounding said brake shoes whereby when said truing grinding wheel is rotated by a grinding wheel to be trued the truing grinding wheel will rotate at a predetermined rate.

2. Truing apparatus for grinding wheels comprising a spindle having a portion upon which a truing grinding wheel can be mounted, a truing grinding wheel secured on said portion, said truing grinding wheel comprising crystalline abrasive in a vitrified bond, a housing, bearings in said housing journalling said spindle, a member connected to and on said spindle and mounted for rotation, brake shoes mounted on said member, springs operating against said brake shoes, screws bearing against said springs to adjust the pressure of said springs against said

brake shoes, and a brake drum surrounding said brake shoes whereby when said truing grinding wheel is rotated by a grinding wheel to be trued the truing grinding wheel will rotate at a predetermined rate.

3. In truing apparatus as claimed in claim 1, the combination with the parts and features therein specified, of the further feature that the truing grinding wheel on the spindle is a silicon carbide wheel.

4. In truing apparatus as claimed in claim 2, the combination with the parts and features therein specified, of the further feature that the truing grinding wheel on the spindle is a silicon carbide wheel.

CHAUNCEY E. SWEETSER.

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