Dec. 29, 1953 K. L. LINDMARK 2,663,978

LAPPER FOR CARBIDE TIPPED TOOLS

Filed Nov. 3, 1952

2 Sheets-Sheet 1

Fig. 1

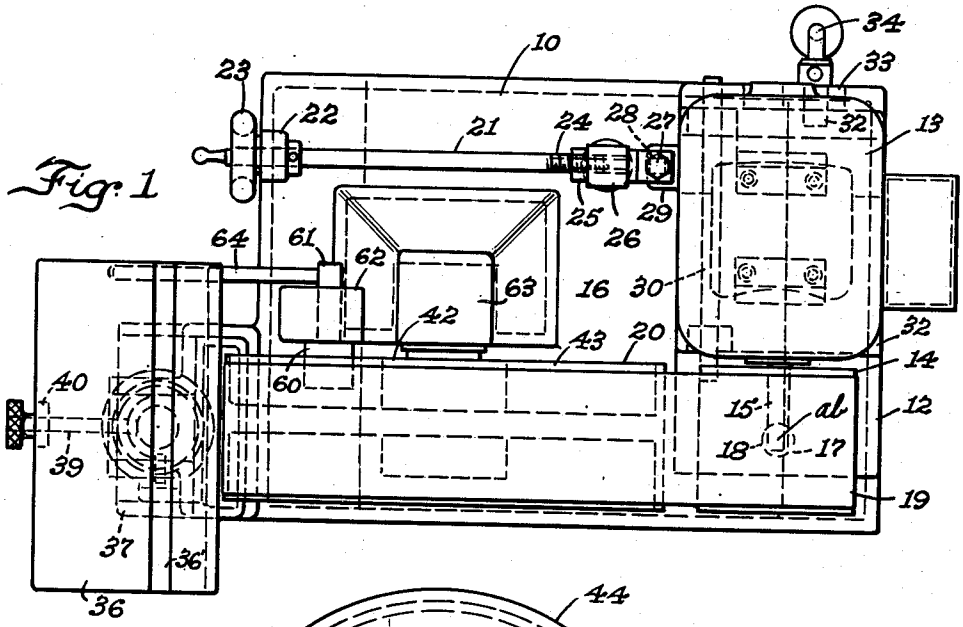
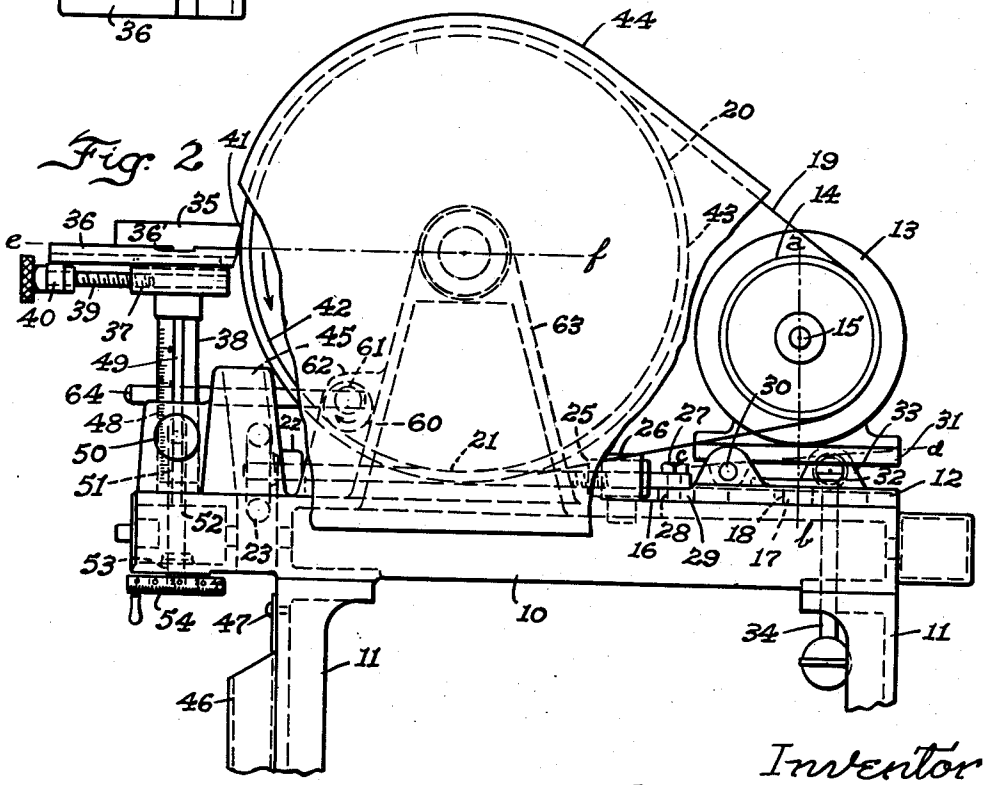


Fig. 2



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Filed Nov. 3, 1952 2 Sheets-Sheet 2

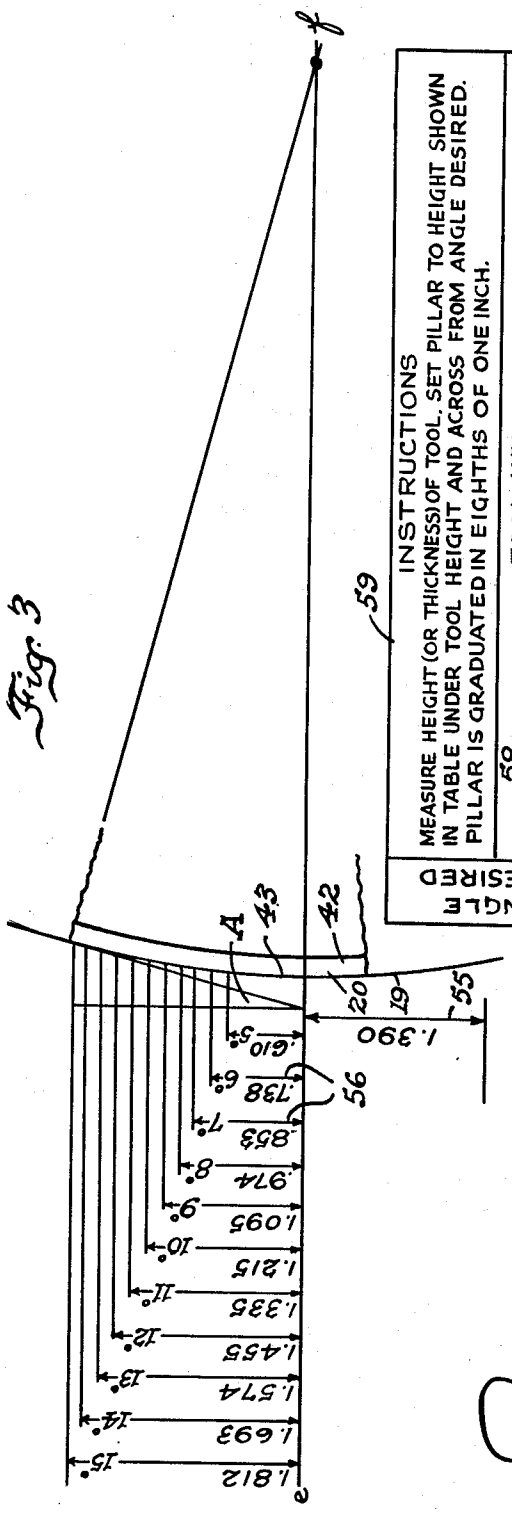


Fig. 3

INSTRUCTIONS

MEASURE HEIGHT (OR THICKNESS) OF TOOL, SET PILLAR TO HEIGHT SHOWN IN TABLE UNDER TOOL HEIGHT AND ACROSS FROM ANGLE DESIRED. PILLAR IS GRADUATED IN EIGHTHS OF ONE INCH.

58

ANGLE DESIRED	TOOL HEIGHT												
	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	1 3/4	2			
5°	1.750	1.625	1.500	1.375	1.250	1.000	.750	.500	.250	0			
6°	1.878	1.753	1.628	1.503	1.378	1.128	.878	.628	.378	.128			
7°	1.993	1.868	1.743	1.618	1.493	1.243	.993	.743	.493	.243			
8°	2.114	1.989	1.864	1.739	1.614	1.364	1.114	.865	.614	.364			
9°	2.235	2.110	1.985	1.860	1.735	1.485	1.235	.985	.735	.485			
10°	2.355	2.230	2.105	1.980	1.855	1.605	1.355	1.105	.855	.605			
11°	2.475	2.350	2.225	2.100	1.975	1.725	1.475	1.225	.975	.725			
12°	2.595	2.470	2.345	2.220	2.095	1.845	1.595	1.345	1.095	.845			
13°	2.714	2.589	2.464	2.339	2.214	1.964	1.714	1.464	1.214	.964			
14°	2.833	2.708	2.583	2.458	2.333	2.083	1.833	1.583	1.333	1.083			
15°	2.952	2.827	2.702	2.577	2.452	2.202	1.952	1.702	1.452	1.202			

TO CALCULATE PILLAR HEIGHT

PH = 7 (SINE OF ANGLE DESIRED) + 1.390 - TOOL THICKNESS

57

Fig. 4

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2,663,978

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LAPPER FOR CARBIDE TIPPED TOOLS

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Application November 3, 1952, Serial No. 318,360

17 Claims. (Cl. 51—135)

1

This invention relates to a machine for lapping carbide tipped tools, the operation of which involves a new and novel method of finishing carbide tipped tool bits.

The principal object is to provide a machine incorporating a wheel of medium large diameter having a wide flat rim with a smooth true periphery which serves as a precision supporting pulley for an endless belt of abrasive material that is kept evenly tensioned and running true while driven by means of a smaller motor driven pulley, the wheel and belt thereby cooperating to provide an endless unyielding precision lapping surface to lap or polish on the arcuate contour of the wheel to obtain a micro-finish on the tip of a cemented carbide tool bit accurately to a predetermined angle determined by the setting of a horizontal tool support at a predetermined elevation with respect to the working face of the wheel.

Another object is to provide a micrometer height adjustment in connection with the slide that serves as an adjustable tool support, and a table of measurements showing the height adjustment for a pillar that carries the tool supporting slide, there being in this table one measurement for each angle of lap calculated according to the tool height measured from the slide.

Another object is to provide a machine of the kind mentioned in which the motor and drive pulley are supported on a base plate oscillatable with respect to the frame on a vertical axis through the horizontal axis of rotation of the pulley at the middle of the pulley and has a screw-thread adjustment operable in either direction to enable making the belt run absolutely true so that the tool to be lapped will be given a true finish.

The machine also incorporates means for quickly releasing the tension on the belt so as to enable quick and easy replacement of worn belts or jogging of the belt to a central position, and also means for applying a braking action on the inside of the rim of the wheel whenever it is desired to stop it quickly.

The invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a top view and Fig. 2 is a side view of a lapping machine made in accordance with my invention;

Fig. 3 is a geometrical diagram showing how the different angles of micro-finishes are obtainable by different heights of adjustments for the tool support pillar in relation to the wheel, and

2

Fig. 4 is a table of height adjustments for the tool support pillar calculated for each of a series of angles in relation to tool heights measured from the tool support slide.

The same reference numerals are applied to corresponding parts in these four views.

Referring to the drawings, the reference numeral 10 designates a table forming a part of the frame of the machine supported on legs 11 at a convenient elevation with respect to the floor. A base plate 12 for support of the electric motor 13 and drive pulley 14 fixed to the armature shaft 15 of the motor is supported on the flat top surface 16 of the table 10 for oscillation relative to a pivot pin 17 fixed to the table 10 and received in a hole 18 in the plate, whereby to permit oscillation of the pulley 14 about a vertical axis *ab* that extends through the axis of the armature shaft 15 at the middle of the pulley 14. This is to enable making the abrasive belt 19 that runs on the pulley 14 and the wheel 20 as a driven pulley track properly and run absolutely true, that is, without any perceptible wabble. A screw-thread adjustment is provided which enables fine adjustment of plate 12 in either direction, the adjusting means including a rod 21 supported for rotation and against endwise movement in a bearing 22 fixed with respect to the top of the table 10. A handwheel 23 is attached to the projecting end of the rod 21 adjacent the bearing 22, and the other end of the rod is threaded, as indicated at 24, and entered in a nut 25 slidable in a bearing 26 fixed to the table 10. The nut 25 carries a pin 27 slidably pivotally engaged in a slot 28 provided in a lug 29 projecting from the plate 12. Thus, one may jog the plate 12 angularly a little one way or the other about the axis *ab* so as to make the belt 19 run without any perceptible wabble, as required for lapping a true finish.

The motor 13 is also swingable on a horizontal axis with respect to plate 12, as indicated by the pivotal mounting 30, with a view to maintaining the abrasive belt 19 under uniform tension by reason of the tendency of the motor 13 to gravitate about the axis 30 away from wheel 20. However, there is provided under one end of the base 31 of the motor 13 a nearly semicircular cam 32 that is provided as a machined end of a shaft mounted in a bearing 33 provided on one end of plate 12. The cam shaft is adapted to be turned by means of a hand lever 34 through 180° to lift the base 31 of the motor 13 to the extent indicated by the dotted inclined line *cd* shown in Fig. 2 whereby to free the belt 19 so

that it may be easily removed and replaced when worn beyond further use. In like manner, if the belt requires jogging one way or the other to a central position on pulley 14 and wheel 20, that can be done readily by releasing the tension in the manner just described.

The wheel 20 and abrasive belt 19 cooperate to provide an endless unyielding precision lapping surface on which to lap or polish on the arcuate contour of the wheel to obtain a micro-finish on the tip of a welded carbide tool bit like that indicated at 35 in Fig. 2. The bit 35 is mounted on a tool support or slide 36 and sometimes it is positioned at a desired angle by abutment alongside a protractor slidable back and forth in a groove 36' extending crosswise of the slide parallel to the working face of the abrasive belt 19. The tool support 36 is adjustable in and out toward and away from the belt 19 and wheel 20 on a table 37 carried on a vertically adjustable pillar 38, the in and out adjustment being obtained by means of a screw 39 rotatable in a bearing 40 on the support 36 and threading in a hole in the table 37. The angle of the surface 41 lapped so accurately on the tip of the tool bit 35 is determined by the elevation of the pillar 38 and hence the support 36 with respect to the working face of the wheel, it being manifest from an inspection of Fig. 2, in which the top of the support 36 on which the tool bit 35 rests is shown disposed in the plane of the horizontal line *ef* passed through the center of the wheel 20, that the higher the elevation of the tool support 36 the greater the angle lapped at 41, measuring from a vertical. Although the surface 41 lapped on this machine is on a radius determined by the radius of the wheel 20, that radius is large enough in relation to the thickness of the tool bit 35 for the surface 41 to be considered substantially flat. Merely by way of example but not in any sense as indicating a limitation on this invention, I may state that the wheel 20 in the machine herein shown is of a 7-inch radius and I have found that this gives good results. The important features, as I at present see them, are:

(1) The lineal speed of the abrasive belt 19;

(2) The type of abrasive belt 19;

(3) The type of cooperating wheel 20, and

(4) The relationship of the tool support 36 to the contour of the wheel 20 so as to obtain the proper angularity of the surface 41 on the carbide tipped tool bit 35.

The abrasive belt 19 and wheel 20 combination replace the so-called "diamond" wheels, which are made of diamond chips or dust. This novel combination does a much better job using far less expensive abrasive belts 19, like the silicon carbide belts that were used heretofore only for polishing glass, ceramics, and non-ferrous materials. There again, the mention of silicon carbide should not be taken as in any sense a limitation on the invention, inasmuch as other abrasive materials could doubtlessly be used to equal, if not better, advantage. The belt 19 is preferably, though not necessarily, one constructed with a cloth backing and made quite thin and pliable and without any appreciable variation in thickness throughout the length thereof, that is, without any overlapping of ends. Inasmuch as the machine must be constructed so that the periphery of the wheel will be true and have a hard surface, because there must be no cushioning action, the wheel 20 is preferably of cast iron or meehanite having a wide flat rim 42 with a smooth true periphery 43. A sheet metal dust and safety guard, only a portion of which is indicated at 44 in Fig. 2, is preferably provided suitably attached to the table 10 and enclosing the major portion of the wheel 20 and pulley 14 and the abrasive belt 19 operating thereon, leaving exposed for performance of the lapping operation a portion of the front of the wheel 20 above and below the tool support 36. Dust discharged downwardly from the front of the wheel is conducted through the passage 45 into a pan 46 that is removably suspended on the front of the machine, as indicated at 47. Any suitable precision bearing support of the kind shown may be provided for the wheel 20, it being, of course, very important that the periphery 43 of rim 42 be truly concentric to the axis of rotation, because its trueness is the basis of the micro-finishes lapped on the tool bits.

The pillar 38 supporting the table 37 is slidable in a vertical guide bearing 48 provided on the front end of the table 10 and has a keyway 49 in which the inner end of a screw 50 is slidably received to hold the pillar against turning, and, when the screw is tightened, lock the pillar in an adjusted position. An axial hole 51 provided in the lower end of the pillar is threaded and receives a pillar adjusting screw 52 that is swivelled in a bearing 53 for rotation with a hand wheel 54. This hand wheel is graduated on the periphery from zero to 125 and the threads on the screw 52 are so related to these graduations that one complete revolution of the wheel means a vertical adjustment of .125, namely, ⅛ inch. The pillar 38 has graduations thereon in eighths of an inch, so that the operator can tell partly from the reading on the pillar 38 and partly by reference to the reading on the wheel 54, what the machine is set for, down to a thousandth of an inch. The wheel 54, of course, turns with reference to an index mark M on the front of the table 10, where the reading on the wheel 54 is taken. The screw 50 is loosened whenever the height adjustment of the tool support 36 is to be changed, and this screw is tightened again after such an adjustment.

Referring to Figs. 3 and 4, the arc 43 represents a portion of the periphery of the rim 42 of wheel 20 with the abrasive belt thereon, as indicated at 19. The dimension 55 is what appears on pillar 38 when the tool support is at zero elevation—namely, at line *ef*, Fig. 2. The dimensions indicated at 56 are elevations above the horizontal plane of the line *ef* for a series of angles 5°–15°. In other words, a line drawn tangent to the arc 43 at any one of these scaled points makes an angle A to the vertical equal to that indicated adjacent the dimension, the angle A illustrated in Fig. 3 being 15°. Now, referring to the table 57 shown in Fig. 4, it will be seen that for each angle from 5° to 15° there is a series of dimensions 58, and that these are in columns under the headings ¼", ⅜", etc., to 2", which refer to tool height or thickness. The operator, as directed in the "Instructions" 59, first determines the tool height; then he sets the pillar 38 to the height shown in the table under that tool height. Thus, if it is say a ¼" tool bit the dimension indicated for a 5° angle is 1.750. That checks with Fig. 3 because 1.390+.610=2.000 and 2.000−.250=1.750. The slide 36 is accordingly set very accurately to lap the specified angle.

In conclusion, attention is called in Figs. 1 and 2 to an eccentric 60 on the end of a stub shaft 61 mounted in a bearing 62 carried by table 10 as a projection on the wheel support 63. A lever 64 is

attached to the shaft 61 and is shown in Fig. 2 in raised operative position holding eccentric 60 frictionally engaged with the inner periphery of the rim 42 to stop rotation of the wheel 20. The lever 64 is otherwise swung downwardly into abutment with the table 10 holding eccentric 60 in retracted relationship to the rim of the wheel 20. Quick stoppage of the wheel saves time for the operator when a belt 19 is worn and has to be replaced.

It is believed the foregoing description conveys a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. In combination, an endless abrasive belt of suitable width, a suitably rotatably supported wheel of appreciable radius having a rim with a wide flat smooth unyielding periphery on which said belt operates under tension, means for driving said belt and wheel, a work support having a surface in a plane parallel to a radius of said wheel on which a tool bit the tip of which is to be lapped by contact with said abrasive belt is adapted to be carried, a pillar on top of which said support is carried for adjustment in a direction parallel to a tangent to said wheel, a guide for said pillar, and means for adjusting said pillar in said guide.

2. The combination recited in claim 1, wherein the means for driving said abrasive belt comprises a pulley on a driven shaft, the combination including a support for said shaft oscillatably adjustable on an axis parallel to a radius of the wheel and passing through the center of the shaft at the middle of the pulley, and screw threaded adjusting means connected with said shaft support to adjust it slightly in either direction to secure straight running of the belt.

3. The combination set forth in claim 1 wherein the means for driving the abrasive belt comprises a pulley on the armature shaft of an electric motor, said motor having its base hingedly mounted on a base plate so as to swing away from the wheel to apply tension to the belt, said base plate being oscillatably adjustable on an axis parallel to a radius of the wheel and passing through the center of the shaft at the middle of the pulley, and screw threaded adjusting means connected with said base plate to adjust it slightly in either direction to secure straight running of the belt.

4. The combination set forth in claim 1 wherein the means for driving the abrasive belt comprises a pulley on the armature shaft of an electric motor, said motor having its base hingedly mounted on a base plate so as to swing away from the wheel to apply tension to the belt, said base plate being oscillatably adjustable on an axis parallel to a radius of the wheel and passing through the center of the shaft at the middle of the pulley, screw threaded adjusting means connected with said base plate to adjust it slightly in either direction to secure straight running of the belt, and manually operable means for raising said motor base relative to said base plate to release tension on the abrasive belt.

5. The combination set forth in claim 1 wherein the means for driving the abrasive belt comprises a pulley on the armature shaft of an electric motor, said motor having its base hingedly mounted on a base plate so as to swing away from the wheel to apply tension to the belt, said base plate being oscillatably adjustable on an axis parallel to a radius of the wheel and passing through the center of the shaft at the middle of the pulley, screw threaded adjusting means connected with said base plate to adjust it slightly in either direction to secure straight running of the belt, manually operable means for raising said motor base relative to said base plate to release tension in the abrasive belt, and manually operable means for applying frictional braking effect on the wheel to stop it quickly.

6. The combination of claim 1 wherein said work support includes a slide on which the work is carried adjustable in a direction at right angles to the pillar and parallel to the radius of said wheel toward and away from the periphery of the wheel.

7. The combination set forth in claim 1 wherein said pillar adjusting means includes means giving a micrometer reading for each adjustment, said combination including a table of figures representing different micrometer measurements in which there is correlated with the angle of lapping desired the predetermined micrometer measurement for pillar adjustment for each of a series of tool bits of different thicknesses.

8. A machine for lapping a micro-finish on the tip of a carbide tipped tool comprising in combination, an endless abrasive belt of suitable width and uniform thickness throughout, said belt carrying an abrasive material in finely divided form on its outer surface, a suitably rotatably supported wheel of appreciable radius having a rim with a wide flat smooth unyielding periphery on which said belt operates under tension, means for driving said belt at a suitable high speed, and means for adjustably supporting a tool bit to be lapped on the tip so that the bit is adjustable to any one of a series of lapping positions parallel to one another and closer to or farther away from a certain radius of the wheel, so that the greater the distance from the said radius the greater the angle of lapping obtainable by reason of the lapping being done on the contour of the wheel.

9. A machine as set forth in claim 8 wherein the abrasive material on the belt is finely divided silicon carbide.

10. A machine as set forth in claim 8 having in combination therewith a table of figures representing different micrometer measurements in which there is correlated with the angle of lapping desired the predetermined micrometer measurement relating to the distance of said tool supporting means from the radius.

11. The combination recited in claim 8, wherein the means for driving said abrasive belt comprises a pulley on a driven shaft, the combination including a support for said shaft oscillatably adjustable on an axis parallel to a radius of the wheel and passing through the center of the shaft at the middle of the pulley, and screw threaded adjusting means connected with said shaft support to adjust it slightly in either direction to secure straight running of the belt.

12. The combination set forth in claim 8, wherein the means for driving the abrasive belt comprises a pulley on the armature shaft of an electric motor, said motor having its base hingedly mounted on a base plate so as to swing away from the wheel to apply tension to the belt, said base plate being oscillatably adjustable on an axis parallel to a radius of the wheel and passing through the center of the shaft at the middle of the pulley, and screw threaded adjusting means connected with said base plate to adjust it

slightly in either direction to secure straight running of the belt.

13. The combination set forth in claim 8 wherein the means for driving the abrasive belt comprises a pulley on the armature shaft of an electric motor, said motor having its base hingedly mounted on a base plate so as to swing away from the wheel to apply tension to the belt, said base plate being oscillatably adjustable on an axis parallel to a radius of the wheel and passing through the center of the shaft at the middle of the pulley, screw threaded adjusting means connected with said base plate to adjust it slightly in either direction to secure straight running of the belt, and manually operable means for raising said motor base relative to said base plate to release tension on the abrasive belt.

14. The combination set forth in claim 8 wherein the means for driving the abrasive belt comprises a pulley on the armature shaft of an electric motor, said motor having its base hingedly mounted on a base plate so as to swing away from the wheel to apply tension to the belt, said base plate being oscillatably adjustable on an axis parallel to a radius of the wheel and passing through the center of the shaft at the middle of the pulley, screw threaded adjusting means connected with said base plate to adjust it slightly in either direction to secure straight running of the belt, manually operable means for raising said motor base relative to said base plate to release tension in the abrasive belt, and manually operable means for applying frictional braking effect on the wheel to stop it quickly.

15. The combination of claim 8 wherein said tool bit supporting means includes a slide on which the work is carried adjustable toward and away from the periphery of the wheel in a plane at right angles to the direction of adjustment relative to the said certain radius of the wheel.

16. The method of precision finishing carbide tipped tool bits on the arcuate contour of a suitably driven finishing wheel which consists in rigidly supporting for sliding feed movement a bit adjacent to and with its tip directed toward the periphery of the wheel and so that the bit lies exactly parallel to a radius of the wheel, and adjusting the support precisely at right angles to the first mentioned position to a precise position where the tangent to the wheel periphery equals the angle to which the tip is to be finished.

17. The method of precision finishing carbide tipped tool bits on the arcuate contour of a wheel which consists in rigidly supporting for sliding feed movement a bit adjacent to and with its tip directed toward the periphery of the wheel and so that the bit lies exactly parallel to a radius of the wheel, driving the wheel while it unyieldingly supports on its periphery an endless thin belt of abrasive material, and adjusting the support precisely at right angles to the first mentioned position to a precise position where the tangent to the wheel periphery equals the angle to which the tip is to be finished.

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