United States Patent

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[54] PORTABLE GRINDING TOOL

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 729,692, May 16, 1968.

[30] **Foreign Application Priority Data**

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Dec. 27, 1967 Japan 42/83308

[52] U.S. Cl. ..... 51/170 EB
[51] Int. Cl. B24b 23/00
[58] Field of Search 51/170.4, 141, 135

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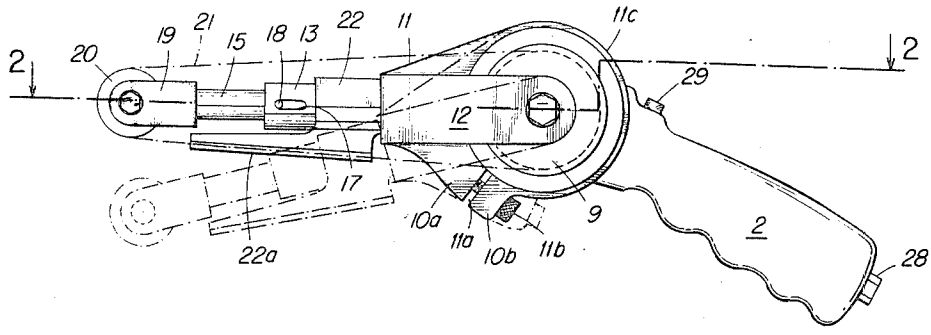
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[57] **ABSTRACT**

A portable grinding tool consisting of a handle, a telescopic holder and arm having a rotatable pulley attached to one end. The telescopic holder is adjustably fastened to the handle at variable angles, and a rotatable driving member positioned within the holder is adapted to be driven by suitable power means so as to rotate a grinding belt entrained about and interconnecting the driving member and the rotatable pulley. Pressure plates for the belt and pulleys of various configurations may be interchangeably mounted for the effective and accurate grinding of different surfaces of a wide range of objects.

24 Claims, 16 Drawing Figures



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SHEET 1 OF 4

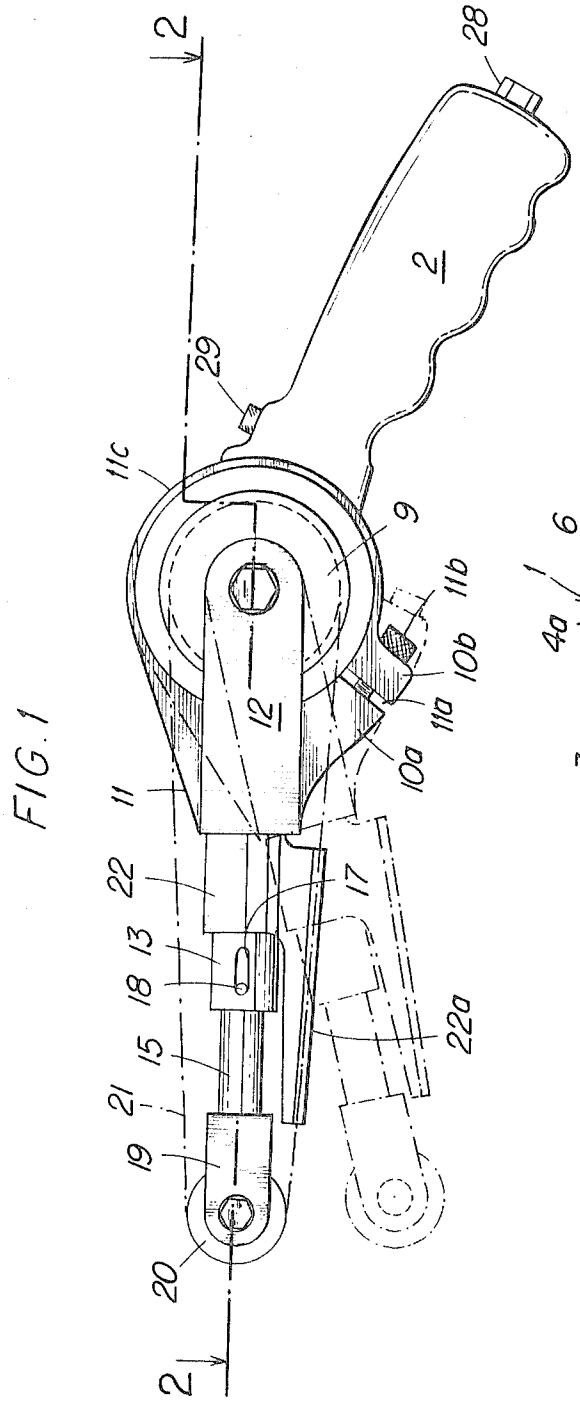


FIG. 1

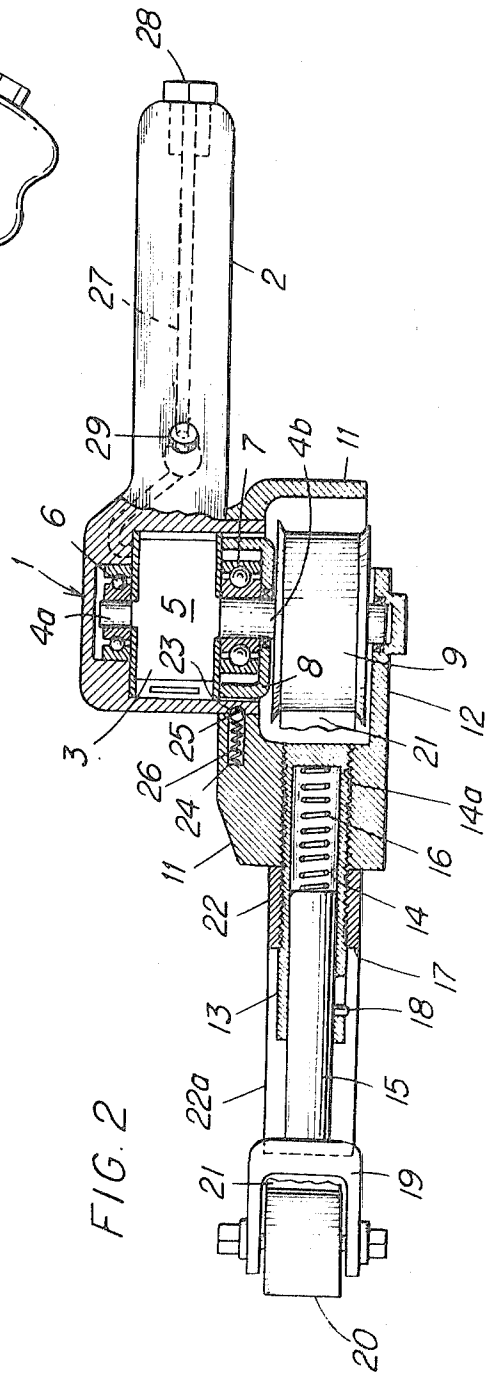


FIG. 2

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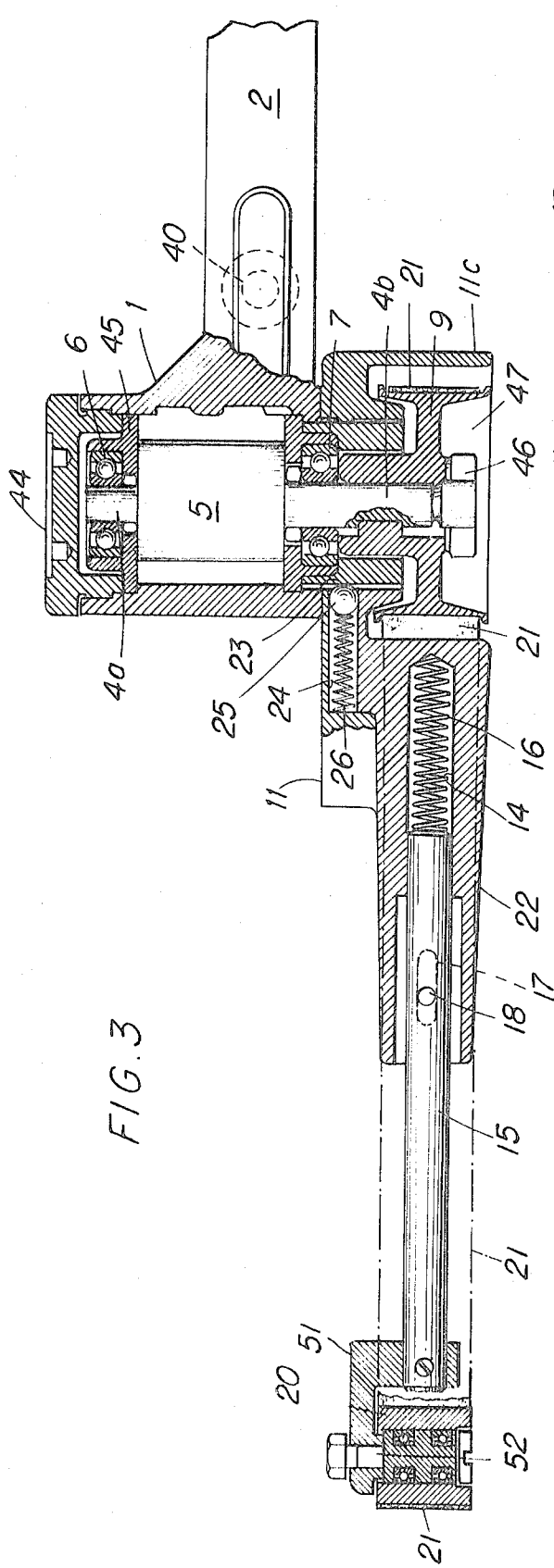


FIG. 3

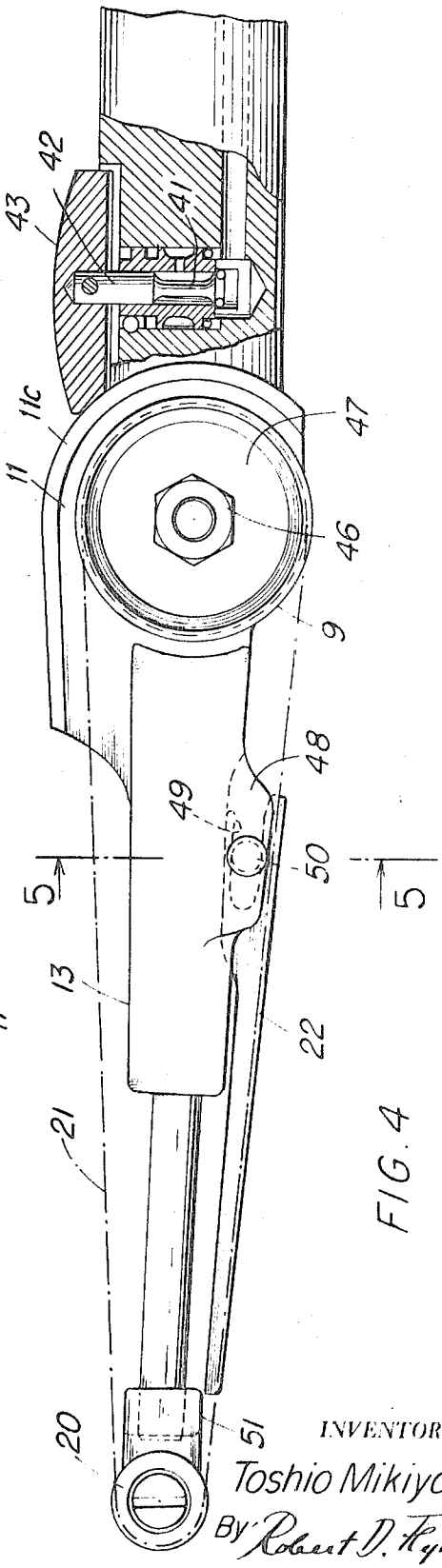


FIG. 4

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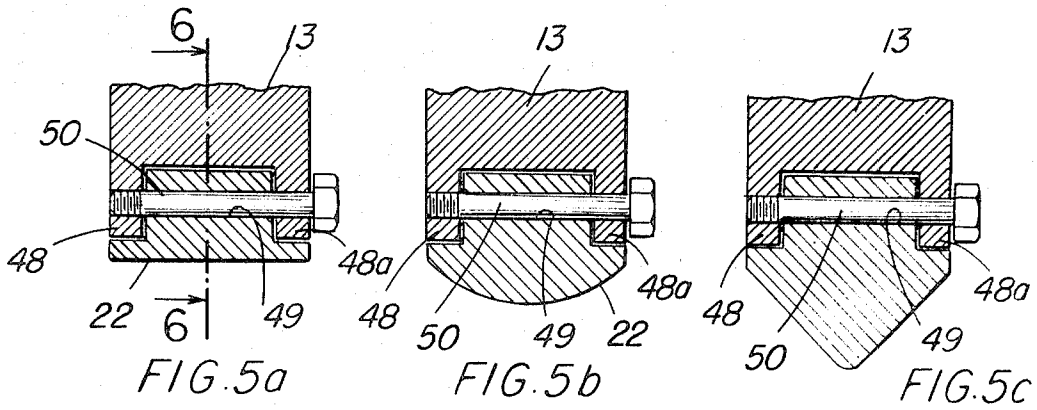


FIG. 5a FIG. 5b FIG. 5c

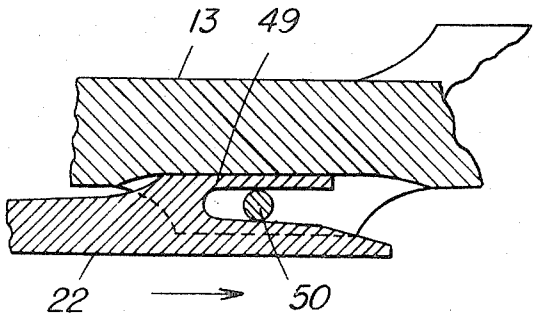


FIG. 6

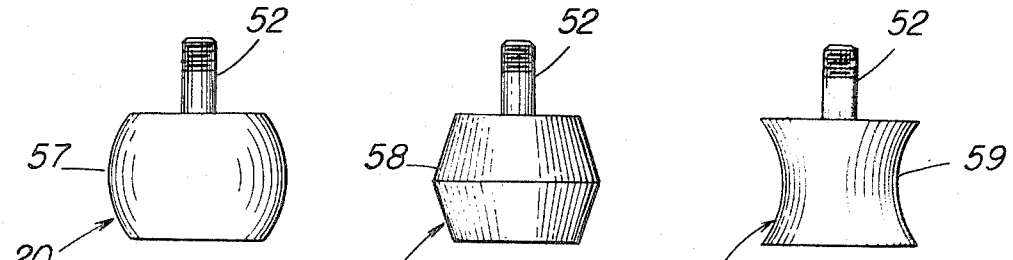


FIG. 8a FIG. 8b FIG. 8c

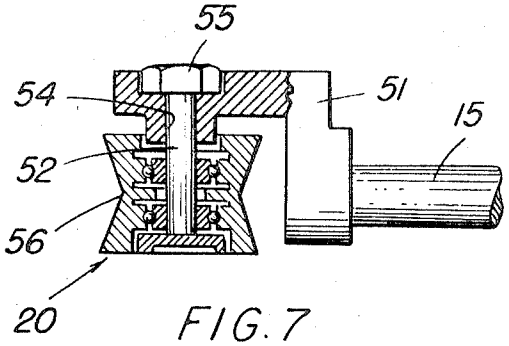


FIG. 7

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FIG. 10

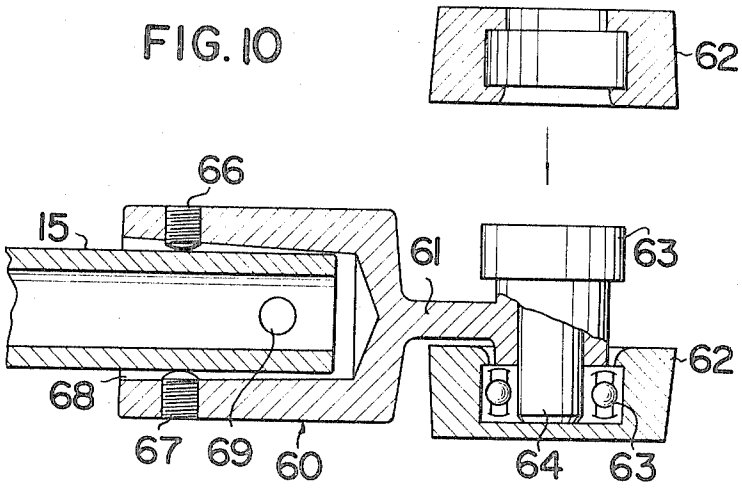


FIG. 9

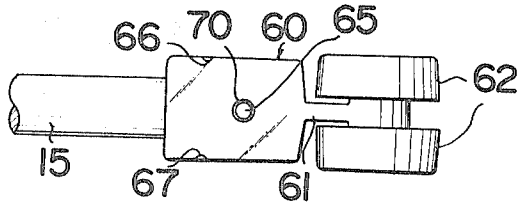


FIG. 11

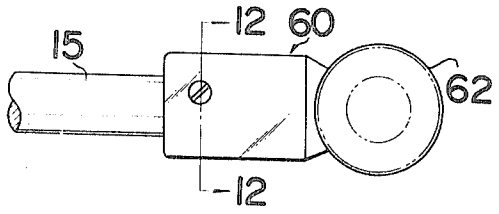
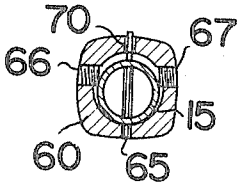


FIG. 12



PORTABLE GRINDING TOOL

This is a continuation-in-part of application Ser. No. 729,692 filed May 16, 1968.

This invention relates to grinding tools and, in particular, relates to improvements in portable grinding tools having adjustable handles adapted to permit grinding operations on various objects and surfaces under different working conditions.

In the prior art many types of grinding tools have been and are being currently utilized. Under certain operating conditions, it may be particularly desirable to utilize an endless, continuously driven grinding belt. However, prior art grinding tools which include such grinding belts require relatively large, heavy and cumbersome devices for the mounting and driving of the belts, thereby rendering manual handling and operation difficult. Moreover, since grinding belts generally have flat grinding surfaces and unless the objects to be ground also have flat surfaces, no unique and desirable grinding effect has been heretofore obtainable. Grinding corners or grooves with prior art grinding belt devices or tools has been practically impossible, and even when efficiently operated were vastly inferior to manual grinding and limited in their applications.

The present invention provides for an improved grinding tool which obviates and eliminates the disadvantages and drawbacks of prior art grinding tools. An important aspect of the present invention lies in providing a portable grinding tool which can be simply and efficiently manipulated by means of a single-handed operation while attaining an accurate degree of grinding proficiency. To this purpose the present invention contemplates the provision of a relatively simple portable grinding tool comprising essentially a grip or handle, a holder and arm having a rotatable belt pulley, with said holder including a rotatable driving member adapted to be driven by a suitable power source, and including an endless grinding belt entrained about and interconnecting said driving member and belt pulley. The grinding belt extends from the handle by means of the holder and arm and is driven in order to provide the same type of smooth grinding operation as in the case of other types of grinding tools. The arm is attached to the holder so as to facilitate relative telescopic motion, and includes elastic material, such as springs, which will impart predetermined and constant operating tension to the grinding belt.

Another feature of this invention is to provide a portable grinding tool with an adjustably mounted grinding belt relative to the grip or handle. The portable grinding tool according to this invention is provided with a grinding belt mounted as described above whereby variation of the mounting angle of the grinding belt relative to the handle facilitates different grinding attitudes irrespective of the type of surface to be ground or of the physical position of the operator.

Another important aspect of this invention is to eliminate excessive deflection of the grinding belt during operation so as to allow accurate grinding of flat work surfaces and the like. For this purpose, the portable grinding tool mounts a pressure plate adjacent to the inner surface of the rotating grinding belt. A deflected belt may be occasionally effective, when grinding, for example, curved or arcuate surfaces, because the belt will contour itself to such work surfaces. However, the deflectable belt, even when tensioned, will not effectively provide the desired grinding action when applied to a flat surface, because the unsupported belt portion will deflect and lose contact with the grinding surface. Mounting a pressure plate adjacent to the under surface of the grinding belt will provide effective grinding pressure against the flat surface of an object to be ground by the grinding belt, thereby greatly enhancing the versatility of the present inventive grinding tool.

It is also preferable that the pressure plate be mounted on the grinding tool so as to be easily removable. As may be evident from the above description, mounting of the pressure plate on the grinding tool may be useful in one phase of the grinding operation but not so in another. Consequently, mounting, removal and replacement of the pressure plate is quite desirable from the standpoint of increasing the applicable range of the present grinding tool. The pressure plate, according to this invention, can be readily removed and mounted by a relatively unskilled operator without difficulty.

A preferred embodiment of this invention contemplates a portable grinding tool capable of accurately grinding surfaces and contours, such as corners and grooves. In this embodiment, the grinding belt pulley is mounted to the extreme end of the arm by means of an L-shaped support so as to eliminate any obstacles or restrictions on one side of the grinding belt. Accordingly, the belt may be maneuvered into corners and grooves of articles to be ground, to provide a high degree of accuracy in grinding and obviate the need for manual afterfinishing of the articles. The belt pulley can be interchanged with various other belt pulleys of differently contoured shapes or surfaces in order to vary the contacting surface of the grinding belt in conformance with the irregular or contoured surfaces of objects to be ground.

Accordingly, it is a primary object of the present invention to provide an improved and novel portable grinding tool.

Another object of the present invention is to provide a grinding tool as herein described which includes a novel grinding belt construction whereby the tool may be used to grind surfaces of various configurations.

A further object of the present invention is to provide a portable belt-type grinding tool as herein described whereby the angular relationship between the grinding belt and tool handle may be adjusted and varied so as to increase the versatility of the grinding tool.

A still further object of the present invention is to provide a grinding tool as herein described including removable pressure plate means which may be mounted adjacent to the inner surface of the grinding belt when grinding flat work surfaces and which may be removed to allow deflection of the grinding belt when grinding contoured work surfaces.

Yet another object of the present invention is to provide a portable grinding tool as herein described including interchangeable and removable belt pulleys about which the grinding belt is entrained and whereby the grinding tool may be adapted to grind corners and grooves of work surfaces at high degrees of accuracy.

For a better understanding of the present invention, reference may now be had to the following detailed description and accompanying drawings, in which:

FIG. 1 is a side view illustrating one embodiment of a portable grinding tool according to this invention;

FIG. 2 is a plan view, partially in section, of the grinding tool, as shown along line 2—2 in FIG. 1;

FIG. 3 is a plan view, partially in section, of a second embodiment of a portable grinding tool according to this invention;

FIG. 4 is a side view of the embodiment of FIG. 3;

FIGS. 5*a* through 5*c* illustrate various illustrative embodiments of pressure plates used in connection with the present grinding tool, as shown in the fragmentary section along line 5—5 in FIG. 4;

FIG. 6 is a cross section shown along line 6—6 in FIG. 5*a*;

FIG. 7 is a sectional plan view, illustrating one embodiment of a grinding belt pulley as shown within the circled portion 7—7 in FIG. 3; and

FIGS. 8*a* through 8*c* are illustrative of various embodiments of grinding belt pulleys used in the grinding tool of the present invention.

Referring now to the drawings, FIGS. 1 and 2 illustrate one embodiment of the grinding tool of this invention, showing a hollow bearing support housing 1 formed at one end of a handle or grip 2. A motor or other rotatable power source 3 may be inserted within said bearing support housing 1, while two shafts 4*a*, 4*b* project from the opposite ends of a rotating member 5 forming part of the motor 3. Shaft 4*a* is rotatably supported by a bearing 6 positioned within bearing housing 1, and shaft 4*b* is rotatably supported by a bearing 7 located within a retaining ring 8 located at the opening of the bearing support housing 1. A rotatable driving wheel 9 is fastened to

the shaft 4*b* projecting from the housing opening by means of a suitable key and keyway. A clamping holder 11 is positioned over the support housing 1 adjacent to the opening. The holder 11 includes a slot 11*a* at one end thereof, having a pair of clamping members 10*a*, 10*b* on both sides of the holder 11, thereby forming a clamping ring member 11*a* whereby a clamping means 11*b*, such as a screw or bolt, may allow suitable fixed or variable movement of the holder 11 and handle 2. Holder 11 includes a shaft support extension 12 on one side adapted to receive the end of shaft 4*b* so as to rotatably guide driving wheel 9. A hollow tube member 13 having a central bore 14 is positioned in support extension 12 by means of a threaded surface 14*a*. A tubular arm 15 extends from bore 14 and includes an internal tension spring 16. Tube member 13 includes an elongated slot 17 having generally semicircular ends. One end of arm 15 includes a supporting base portion 19 attached firmly thereto, whereas the other end of said arm 15 extends into the central bore 14 in tube member 13. A projecting means 18 extends from the side of tubular arm 15 and projects through elongate slot 17. The supporting base portion 19 is a clevis adapted to rotatably mount a pulley 20 and a mobile wheel between the arms of the clevis. An endless resilient grinding belt 21 is mounted on and entrained to rotate about driving wheel 9 and belt pulley 20. The center portion of tube member 13 supports, in fixed relationship, a pressure plate 22 including pressure shoes 22*a* which are applied to the inner surface of said grinding belt 21. A number of suitably spaced detents 23 are arranged on the outer surface of bearing support housing 1. A ball 25 positioned in a bore 24 in holder 11 is adapted to contact detents 23 under the urging of a resilient tension spring 26 located in the bore 24. A hole 27 extends through handle 2 along its length, and at the free end of the handle 2 connects to a fitting joint 28. By means of joint 28 and through hole 27 compressed air or electric current (depending on the type of motive power) is supplied to power source 3. When using compressed air, a control port 29 in handle 2, and connected to hole 27, may be utilized to control the amount of compressed air flowing to power source 3.

From the foregoing description it becomes evident that supplying compressed air and the like to power source 3 through hole 27 will impart rotation to rotating member or impeller 5 and correspondingly rotate driving wheel 9 by means of shafts 4*a* and 4*b*. In this manner, the grinding operation of the tool is attained through the resulting rotation of grinding belt 21 over the driving wheel 9 and belt pulley 20. In this embodiment, the pulley 20 is mounted to the end of arm 15 which is constantly being outwardly extended under the tension exerted by elastic spring member 16, thereby imparting the required tension to the grinding belt 21 and effectively transmitting the driving power of said driving wheel 9, whereby smooth and constant rotation of the grinding belt 21 is obtained. The projecting means 18 in slot 17 limits the outward motion of arm 15. Pressure shoes 22*a* of pressure plate 22 will guide the movement of grinding belt 21, whereby along with the tensioning of the grinding belt 21, the latter is effectively maintained against the surface to be ground during grinding and to thereby obtain accurate grinding. Through loosening clamping means 11*b* holding clamping members 10*a* and 10*b*, the angle of handle 2 relative to arm 15 and to holder 11 may be adjusted and varied optionally as shown in FIG. 1 through the dotted lines, whereby grinding belt 21 may be positioned at variable angles with respect to handle 2. This will facilitate the grinding of articles positioned at various degrees of inclination without undue difficulties.

A second embodiment of the invention is illustrated in FIGS. 3 to 6 of the accompanying drawings. This embodiment is generally similar to the one illustrated in FIGS. 1 and 2, but differs in the construction of certain of the grinding tool components. All components not designated by reference numerals may be assumed to be identical to those in the first described grinding tool embodiment. In the embodiment shown in 4*b*, 3–6, the compressed air is controlled by a control port 40 attached to the side of handle 2, and control of the compressed air to the power source is achieved by means of a valve 41 constituting the shaft 42 of an actuating member 43. (FIG. 4) Bearing support housing 1 is equipped with a cover 44 in lieu of an opening as shown in FIGS. 1 and 2, and a supporting ring 45 including bearing 6 is fastened to lid 44. Driving wheel 9 has a drum-shaped, hollow center and is fastened to the end of shaft 4*b*, the latter of which is cantilevered without shaft support extension 12 as in the case of FIGS. 1 and 2. A clamping nut 46 at the end of shaft 4*b* is inserted within a recess 47 formed on the side of driving wheel 9 so as not to project outwardly thereof. Holder 11 and arm guide 13 shown in FIGS. 1 and 2 are integrally formed in this embodiment, so in effect arm guide 13 projects from one side of a holder 11. Pressure plate 22 having pressure shoe 22*a* in FIGS. 1 and 2 is fastened to the center portion of arm guide 13 with its cylindrically shaped base, however in this embodiment a pair of supporting bases 48, 48*a* are positioned on either side of the bottom of arm guide 13 in FIG. 5. A projection 49 formed at the base of pressure plate 22 is inserted between the supporting bases or forks 48, 48*a* and a mounting rod or shaft 50 extending through supporting bases 48, 48*a* is inserted through the projection 49, said projection being narrow at one end and adapted to be inserted over said shaft 50 with a gradually opening end portion.

In mounting the pressure plate 22 as shown in FIGS. 3–6, projection 49 of plate 22 is moved toward arm guide 13 and by manipulation toward shaft 50 (FIG. 6), may be readily mounted on the grinding tool. While grinding belt 21 is rotating, a frictional working force is generated through friction toward said pressure plate 22 in the direction of the arrow shown in FIG. 6, tending to maintain the pressure plate 22 in mounted position. Removal of the pressure plate 22 is easily accomplished by manipulating it in opposition to the direction of the arrow in FIG. 6 while the driving belt 22 is stationary. Accordingly, the pressure plate 22 may be alternatively mounted or removed depending on whether flat surfaces or curved surfaces are to be ground.

FIGS. 5A, 5B, and 5C of the drawings illustrate various embodiments of pressure plate 22. FIG. 7 illustrates the mounting construction for belt pulley 20 for the second tool embodiment. In the embodiment shown in FIGS. 1 and 2, belt pulley 20 is supported by I-shaped supporting clevis 19 at the end of arm 15. Although use of such an I-shaped supporting clevis 19 will provide adequate support for the belt pulley 20, the supporting clevis 19 projecting along the sides of the belt 21 will prevent the effective grinding of corner surfaces of articles. In this second embodiment, an L-shaped supporting bracket 51 is attached to the end of arm 15, whereby a cantilevered shaft 52 mounted on the supporting bracket 51, rotatably supports grinding belt pulley 20. Thus, the other side of grinding belt 21 is free to be inserted into corners and grooves of articles for this type of accurate grinding. In attaching shaft 52 to the supporting bracket 51, belt pulley 20 is mounted on the shaft 52 with a flange 53 on one end, and shaft 52 is inserted through a shaft bore 54, and retained by clamping means 55. By loosening said clamping means 55, the shaft 52 may be pulled out from the support bracket 51, so as to interchange belt pulleys 20. The belt pulley 20 may be exchanged from flat surfaced ones as shown in FIGS. 1 and 2, or FIGS. 3 and 4, for one with V-shaped concave surface as in FIG. 7 or for one with an arc-shaped convex surface 57 as shown in FIG. 8A, V-shaped convex surface 58 as shown in FIG. 8B, and for arc-shaped concave surface 59 as shown in FIG. 8C. Thus, belt pulleys 20 having different contoured surfaces will provide varied contours to the grinding surfaces of grinding belt 21, thereby effectively contouring the rotatable belt pulley 20 in accordance with the surface configurations of objects to be ground, and in particular in relation to cases where uneven surfaces such as corners and grooves are to be ground.

Referring to FIGS. 9 and 10, there is shown a modification of the present invention whereby a pulley support device is removably and adjustably connected to the end of arm 15. Corresponding elements in FIGS. 9–12 are given the same

reference numeral designations. The pulley support device includes an adjustment member 60 which has a bore 68 therein which is adapted to fit over the end of the arm 15. The bore 68 in adjustment member 60 is of a larger diameter than that of the end of arm 15, and in this embodiment is tapered out toward the opening of bore 68. Protruding from adjustment member 60 is a support arm 61 to which the pulleys 62 are rotatably secured. In the embodiment shown the support arm 61 carries two shafts (or protrusions) 64. On each shaft 64 is mounted a ball bearing 63 on which the pulleys 62 are rotatably mounted. Pulleys 62 may be press fit over ball bearings 63 or secured thereto by means of a setscrew, or the like. Equivalent alternative mounting methods for pulleys 62 should be apparent to those skilled in the art.

The adjustment member 60 is mounted over the end of arm 15 and a pin 65 (see FIGS. 9 and 12) is inserted through a hole 69 in arm 15 and through mating holes 70 in adjustment member 60. After the pin 65 is inserted and the position of member 60 is set, two screws 66 and 67, which are threadably mounted in member 60, are tightened to fixedly locate the adjustment member 60 with respect to the end of arm 15. In this manner, as seen most clearly in FIGS. 10 and 12, the alignment of the arm 15 along the longitudinal axis of pin 65 with respect to adjustment member 60 can be adjusted in order to insure that the pulleys 62 are properly aligned with the drive pulley 3 (shown in FIG. 1, for example). Preferably the rotating axis of the drive pulley 3 and of pulleys 62 are adjusted to be in parallel. Pin 65 acts as a pivot member or fulcrum about which adjustment member 60 is movable relative to arm 15.

When the apparatus is adjusted, adjustment member 60 is supported firmly at three points; at the end of the two setscrews 66 and 67, and at the inner wall of the adjustment member 60. It is possible to maintain stable operation by means of this configuration in spite of the vibrations which occur at high operating speeds. Also, by virtue of the adjustment mechanism, it is possible to prevent the grinding belt from dropping off the main wheel and the pulley, thereby facilitating the operation of the grinding apparatus.

Another feature of the embodiment shown in FIGS. 9–12 is that there are no protruding members (such as members 51 and 55 of FIG. 7) on the outside edges of the pulleys 62. By means of this embodiment, the grinding apparatus may be more easily utilized to grind narrow crevices, deep grooves and corners.

By virtue of the fact that alignment of the supporting member 60 with respect to the arm 15 can be facilitated, strains in the grinding belt can be more efficiently absorbed and it is possible to keep the grinding belt properly in place over the pulleys 62 even when the belt is being run at high speeds. Also, by adjusting the alignment between supporting member 60 and arm 15, it is possible to prevent the pulley from falling off due to excess warp in the endless grinding belt or due to the rotating axis of the drive wheel and the rotating axis of the pulley not being parallel. Thus, the adjustment device shown in FIGS. 9–12 enables more precise alignment and adjustment of the grinding apparatus to compensate for the various imperfections and variations in apparatus which may arise.

What is claimed is:

1. A portable grinding tool comprising;

handle means;

a holder having a bore therein, said holder including a clamping ring for adjustably fastening said holder to said handle means, a slot extending through said clamping ring, and adjusting means interconnecting the ends of said clamping ring adjacent said slot for alternatively loosening and tightening said clamping ring ends together, such that the angular relationship between said holder and said handle means is adjustable;

a projecting arm member positioned within said bore and having one end extending from said holder;

driving wheel means rotatably mounted on said holder and adapted to be driven by suitable driving means;

a pulley rotatably mounted on the projecting end portion of said arm member; and

an endless grinding belt interconnectingly encompassing said driving wheel means and said pulley for rotation therewith.

2. A grinding tool as defined in claim 1 wherein said clamping ring includes clamping seats located on both sides of said slot, and wherein said adjusting means interconnects said clamping seats for loosening and tightening said clamping ring.

3. A grinding tool as defined in claim 1 wherein said handle means includes a portion extending into said clamping ring.

4. A grinding tool as defined in claim 1 wherein said handle means includes a housing containing drive means therein, said housing being adjustably fastened to said holder.

5. A grinding tool as defined in claim 1 including cooperating ball and detent means in said holder adapted to determine the relative angular position between said holder and said handle means.

6. A grinding tool as defined in claim 5 wherein said handle means includes detents formed therein and wherein said holder includes spring-biased ball means therein which cooperate with said detents.

7. A grinding tool as defined in claim 1 including a pulley support means adjustably coupled to the free end of said projecting arm, said pulley being rotatably mounted on said pulley support means.

8. A grinding tool as defined in claim 7 wherein said pulley support means includes a bore therein adapted to receive the free end of said projecting arm, the diameter of said bore being larger than the outer diameter of said projecting arm.

9. A grinding tool as defined in claim 8 wherein said pulley support means includes a pin adapted to pass through holes in said pulley support means and through a hole in the free end of said projecting arm.

10. A grinding tool as defined in claim 9 further comprising a pair of setscrews threadably inserted in the walls of said pulley support means for fixedly securing said pulley support means to the free end of said projecting arm member.

11. A grinding tool as defined in claim 10 wherein said projecting arm and said pulley support means are movable with respect to each other along the longitudinal axis of said pin, said setscrews fixedly securing said projecting arm and said support means relative to each other at a predetermined point along the longitudinal axis of said pin.

12. A grinding tool as defined in claim 11 wherein said projecting arm and said pulley support means are movable with respect to each other about the longitudinal axis of said pin, said setscrews fixedly securing said projecting arm and said support means at a predetermined relative position.

13. A grinding tool as defined in claim 1 including pressure plate means fastened to said holder, said pressure plate means being adapted to contact portions of said grinding belt to support said belt.

14. A grinding tool as defined in claim 13 wherein said pressure plate means comprise contact shoe surface means engaging the inner surface of portions of the grinding belt run between said driving wheel means and said pulley.

15. A grinding tool as defined in claim 13 wherein said pressure plate means are removably mounted on said holder.

16. A grinding tool as defined in claim 15 including a projection on said pressure plate means, complementary recess means on said holder adapted to receive said projection, and fastener means projecting through aligned apertures in said projection and holder recess means for mounting said pressure plate means on said holder.

17. A grinding tool as defined in claim 1 including a generally L-shaped bracket means fastened to the free end of said projecting arm member, cantilever shaft means projecting from said bracket means, and said pulley being rotatably mounted on said shaft means.

18. A grinding tool as defined in claim 17 wherein said pulley is detachably mounted on said shaft means so as to be interchangeable with other pulleys.

19. A grinding tool as defined in claim 1 wherein said pulley is detachably mounted on said projecting arm end portion so as to be interchangeable with other pulleys.

20. A portable grinding tool comprising:

handle means;

a holder attached to one end of said handle means, said holder having a bore therein;

a projecting arm member positioned within said bore and having one end extending from said holder;

driving wheel means rotatably mounted on said holder and adapted to be driven by suitable power means;

a pulley support means adjustably coupled to the free end of said projecting arm, said pulley support means including a bore therein adapted to receive the free end of said projecting arm, the diameter of said bore being larger than the outer diameter of said projecting arm;

a pulley rotatably mounted on said pulley support means; and

an endless grinding belt interconnectingly encompassing said driving wheel means and said pulley for rotation therewith.

21. A grinding tool as defined in claim 20 wherein said pulley support means includes a pin adapted to pass through holes in said pulley support means and through a hole in the free end of said projecting arm.

22. A grinding tool as defined in claim 21 further comprising a pair of setscrews threadably inserted in the walls of said pulley support means for fixedly securing said pulley support means to the free end of said projecting arm member.

23. A grinding tool as defined in claim 22 wherein said projecting arm and said pulley support means are movable with respect to each other along the longitudinal axis of said pin, said setscrews fixedly securing said projecting arm and said support means relative to each other at a predetermined point along the longitudinal axis of said pin.

24. A grinding tool as defined in claim 23 wherein said projecting arm and said pulley support means are movable with respect to each other about the longitudinal axis of said pin, said setscrews fixedly securing said projecting arm and said support means at a predetermined relative position.

* * * * *