United States Patent [19]

Lindsay et al.

[11] **3,854,252**

[45] **Dec. 17, 1974**

[54] **WORK SUPPORT SHOES FOR CENTERLESS GRINDING MACHINES**

[76] Inventors: **Arwin O. Lindsay,** 13445 Oscar St., Sylmar, Calif. 91342; **Kenneth C. Boalen,** 1839A Verdugo Loma Dr., Glendale, Calif. 91208

[22] Filed: **July 26, 1973**

[21] Appl. No.: **382,872**

[52] **U.S. Cl.** ..... **51/238 GG,** 51/103 R

[51] **Int. Cl.**..... **B24b 5/34,** B24b 41/06

[58] **Field of Search** .... 51/103 R, 103 WH, 103 TF, 51/238 GG, 238 R, 238 S, 239

[56] **References Cited**

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Primary Examiner—Donald G. Kelly
Assistant Examiner—Marc R. Davidson
Attorney, Agent, or Firm—Huebner & Worrel

[57] **ABSTRACT**

Work support shoes for a centerless grinding machine have shank and contact portions. The shank portions are arranged for mounting on the grinding machine and are made of a phenolic base material having a sufficient degree of flexibility to dampen vibrations imparted thereto. The contact portions are secured to and supported by the shank portions to contact and bear against a workpiece being ground and are made of a high density ceramic wear resistant material.

5 Claims, 11 Drawing Figures

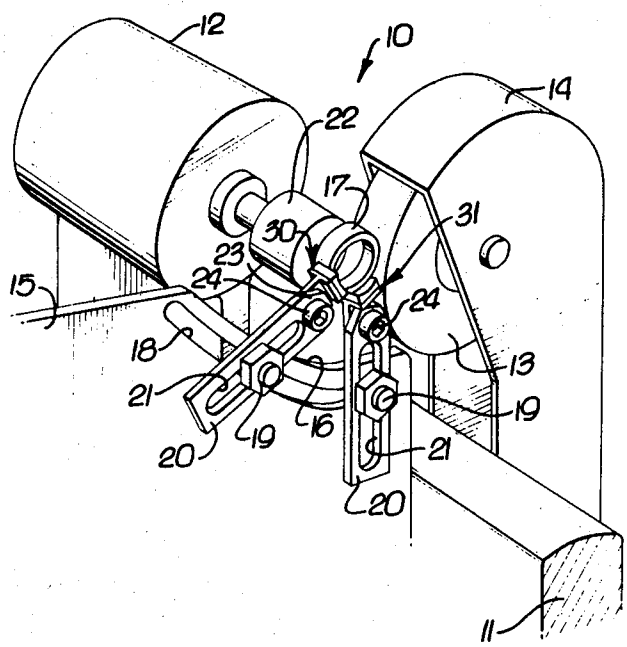


FIG. 1.

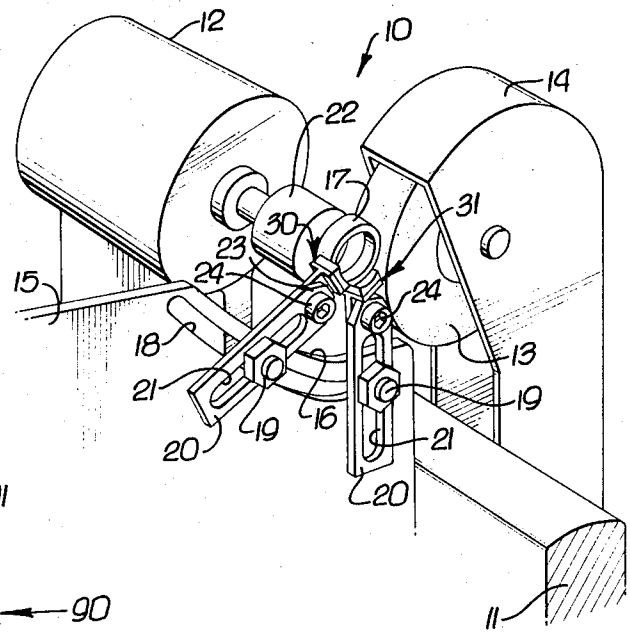


FIG. 9.

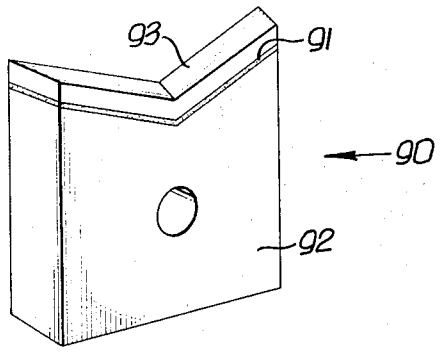


FIG. 2.

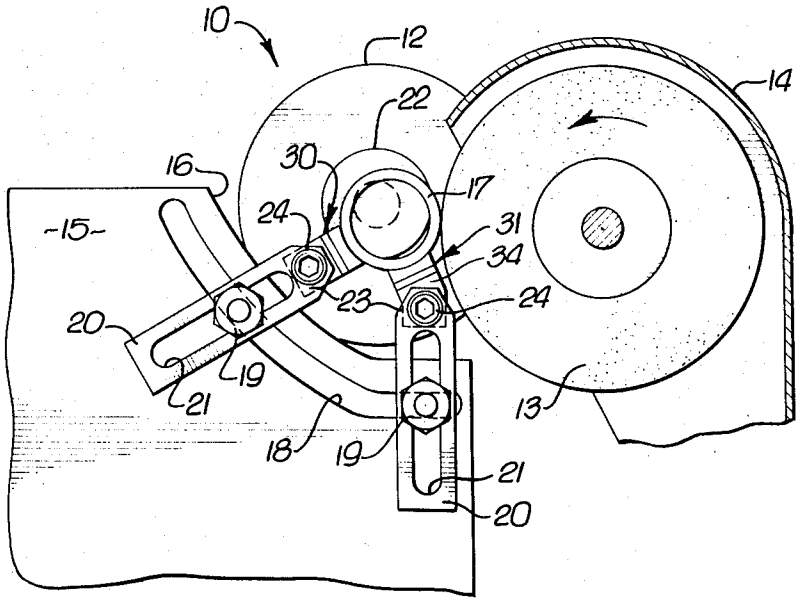


FIG. 4.

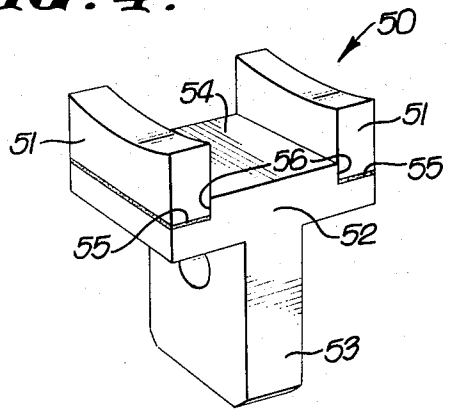


FIG. 3.

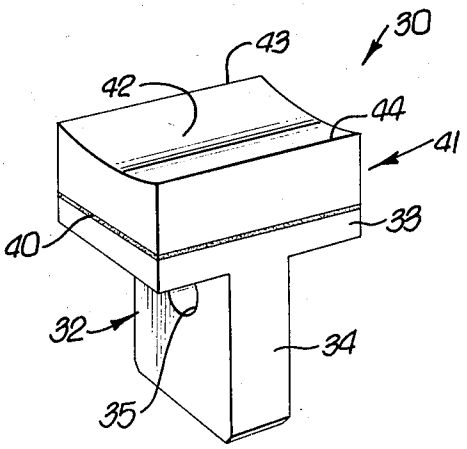


FIG. 5.

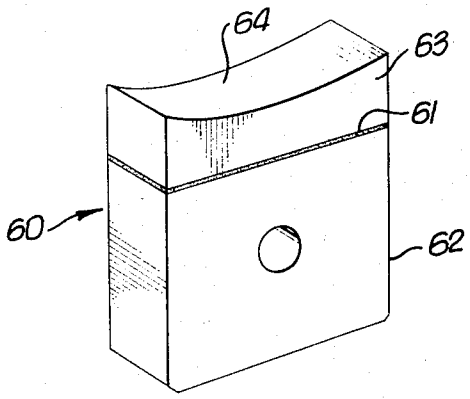


FIG. 7.

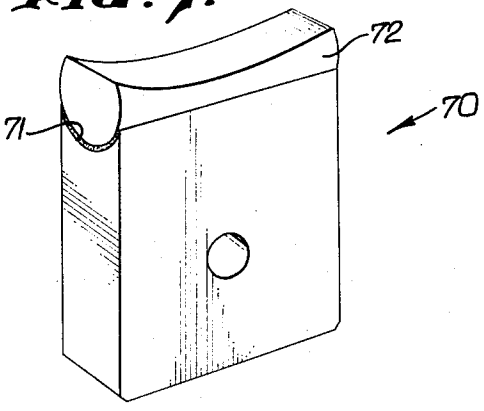


FIG. 6a.

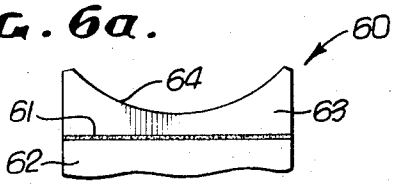


FIG. 6b.

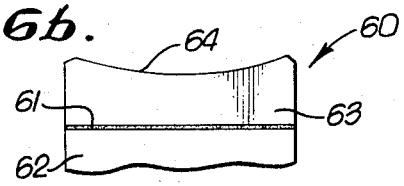


FIG. 6c.

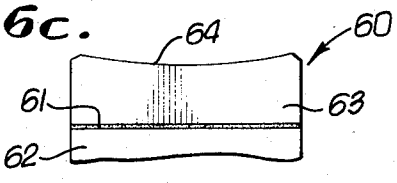
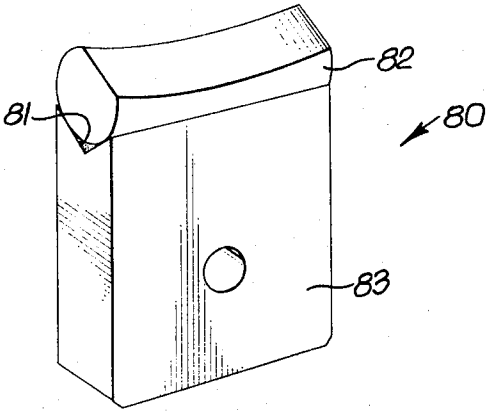


FIG. 8.



WORK SUPPORT SHOES FOR CENTERLESS GRINDING MACHINES

BACKGROUND OF THE INVENTION

The present invention relates to work shoes for centerless grinding machines. Such work shoes function as guides for holding workpieces properly orientated while they are being ground in the grinding machine.

Heretofore, work shoes have been generally made of carbide tipped steel. Unfortunately, such prior art shoes have been found to be subject to the drawbacks of excessive vibration and rapid wear of their carbide tips. Excessive vibration of the work shoes causes movement of the workpieces while they are being ground while excessive wear of the carbide tips causes gradual displacement of the workpieces from their properly orientated positions. Both of these drawbacks or disadvantages limit the precision of the grinding operation and consequently, the precision of the parts formed from the workpieces.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved work shoe for a centerless grinding machine which is not subject to the aforementioned disadvantages of prior art work shoes.

It is further an object of the present invention to provide improved work shoes as set forth characterized by having shank portions having a sufficient degree of flexibility to dampen vibrations imparted thereto by a grinding machine, and contact portions for supporting workpieces being ground made of wear resistant material so as not to be subject to excessive and/or uneven wear.

In accomplishing these and other objects, there is provided in accordance with the present invention work shoes for centerless grinding machines having shank portions and contact portions. The shank portions are arranged for mounting on the grinding machine and are made of phenolic base material having a sufficient degree of flexibility to dampen vibrations imparted thereto. The contact portions are secured to and supported by the shank portions in position to contact and bear against a workpiece being ground, and are made of high density ceramic wear resistant material.

Additional objects of the present invention reside in the specific construction of the embodiments of work shoes hereafter shown in the drawings and described in connection therewith.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a centerless grinding machine having a pair of work shoes according to the present invention mounted therein.

FIG. 2 is a side elevation view of the grinding machine of FIG. 1.

FIG 3 is a perspective view of one of the work shoes of the grinding machine of FIG. 1.

FIG. 4 is a perspective view of another embodiment of work shoe according to the present invention.

FIG. 5 is a perspective view of still another embodiment of work shoe according to the present invention.

FIGS. 6*a* — 6*c* are side elevation views of the work shoe of FIG. 5 illustrating different curvatures of its contact surface.

FIG. 7 is a perspective view of yet another embodiment of work shoe according to the present invention.

FIG. 8 is a perspective view of a modified form of work shoe of FIG. 7.

FIG. 9 is a perspective view of an additional embodiment of work shoe according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in more detail, there is shown in FIGS. 1 and 2 a conventional centerless grinding machine generally identified by the numeral 10. The machine 10 includes a frame portion 11 having an offset magnet chuck 12 and a grinding wheel 13 mounted in a conventional manner thereon. A protective shield 14 is formed around the outboard side of the grinding wheel 13.

An upward projecting plate-like portion 15 is formed as part of the grinder frame 11. The plate 15 is positioned in alignment with the grinding wheel 13 and has its edge 16 adjacent the grinding wheel 13 shaped so that a workpiece 17 may be positioned thereabove in a proper orientation for grinding by the wheel 13. The magnetic portion 22 of the chuck 12 is positioned to hold the workpiece 17 in this grinding position.

A partially curved slot 18 is formed in the plate 15 adjacent the edge 16. The shape and curvature of the slot 18 conforms with the shape of the edge 16. Clamped to the plate 15 by bolts-nut combination 19 to extend therefrom towards the grinding position for the workpiece 17 are two shoe support arms 20. The arms 20 have slots 21 of uniform width formed along the greater portion of their lengths through which the bolts 19 extend. Formed in the outwardly positioned ends 23 of each of the arms 20 are holes through which the bolts of bolt-nut combinations 24 extend.

Clamped on the upper ends of each of the arms 23 by one of the bolt-nut combinations 24 are work shoes 30 and 31. The work shoe 30, which is positioned to the left in FIG. 2, is shown on an enlarged scale in FIG. 3.

Referring to FIG. 3, the work shoe 30 has a base or shank portion 32 made up of a planar top 33 and a downwardly extending stem 34. The planar top 33 is rectangularly shaped and the stem 34 extends perpendicularly to the upper and lower surfaces of the top 33 across its width. The stem 34 is also preferably rectangularly shaped and is positioned relative to the top 33 so that the top 33 extends symmetrically to each side thereof. Thereby, the shank 32 defined by the stem 34 and top 33 has a T-shaped cross-section. A hole or opening 35, the axis of which extends substantially parallel to the planar top 33, extends through the stem 34. The hole 35 is dimensioned for receiving the bolt 24 and is centrally formed in the stem 34 so as to permit the stable mounting of the shank 32 on one of the support arms 20.

The shank 32 defined by the stem 34 and top 33 is formed of a single piece of phenolic base material having a sufficient degree of flexibility to dampen vibrations imparted thereto by the grinding machine 10. A suitable phenolic base material is described and has its properties set out in our U.S. Pat. No. 3,449,867, issued 17th June 1969 and is a paper based phenolic plastic employing a paper base bonded by a phenol for-

maldehyde resin of electrical grade. The use of such a phenolic base material for the shank **32** minimizes vibration and chatter of the shank and also minimizes transfer of kinetic energy thereby.

Adhesively secured by a layer of an epoxy resin adhesive **40** on the flat upper surface of the shank top **33** is the contact portion **41** of the work shoe **30.** The contact portion **41** has a flat bottom corresponding in shape to the upper surface of the shank top **33** and an inwardly curved or concave top contact surface **42.** The contact surface **42** curves along only one axis, from its side edge **43** to its side edge **44,** to have a curvature corresponding to the outer surface of the annular workpiece **17.**

The contact portion **41** of the work shoe **30** is made of a single piece of a suitable high density low porosity wear resistant ceramic material. A suitable ceramic material is described and has its properties set out in the above-mentioned U.S. Pat. No. 3,449,867.

Referring again to FIGS. **1** and **2,** the work shoe **31** there shown is identical to the work shoe **30** with the exception that the stem **34** of its shank is bent instead of being straight. Thereby, the shoe **31** may be mounted on the right positioned arm **20** with the lower part of the stem **34** aligned with the longitudinal axis of the arm **20** and the shoe contact portion **41** facing slightly to the left.

In operation of the grinding machine **10,** the annular workpiece **17** may be ground or finished in the following manner. The work shoes **30** and **31** are mounted on the upper ends of the support arms **20** in the manner shown in FIG. **2** and the arms **20** are properly positioned and clamped in place by tightening the bolt-nut combinations **19.** The workpiece **17** is positioned in the curved seat defined by the shoes **30** and **31** in contact with magnetic clutch portion **12.** The grinding wheel **13** is then driven counterclockwise (as viewed in FIG. **2**) with the result that the workpiece **17** rotates in place and its outside periphery is ground by the wheel **13.**

A modified form of work generally identified by the numeral **50** is shown in FIG. **4.** The shoe **50** is constructed in a manner similar to the construction of the shoe **30** with the following exceptions. Its contact portion is made up of two identically shaped spaced apart support parts **51** instaed of one solid piece. The parts **51** each have substantially the same cross-sectional shape as the contact portion **41** of the shoe **30.** The parts **51** are adhesively secured on opposite ends of the shank top **52** parallel to the shank stem portion **53.** The portion **54** of the shank top **53** which extends between the contact parts **51** is elevated above the surfaces **55** upon which the parts **51** are mounted so as to provide vertical walls **56** which aid in supporting the contact parts **51** on the shank top **52.**

FIG. **5** illustrates another embodiment of work shoe which is generally designated by the numeral **60.** The shoe **60** is constructed like the aforedescribed work shoe **30** with the exception that the shank top **61** is formed as a continuation of the shank stem **62.** The shoe contact portion **63** is dimensioned to be the same size as the shank top **61** for mounting thereto.

FIGS. **6***a* – **6***c* are side views of the shoe **60** and illustrate that the shoe contact surface **64** which contacts a workpiece may be made of any curvature suitable for contacting the specific workpiece to be finished.

FIG. **7** illustrates a work shoe generally identified by the numeral **70.** The shoe **70** is constructed like the shoe **60** with the exception that the shank top **71** is concavely shaped and the lower portion of the shoe contact portion **72** has a curvature corresponding to the shank top **71** so as to securely interfit therein.

FIG. **8** illustrates a work shoe generally identified by the numeral **80.** The shoe **80** is constructed like the shoe **70** with the exception that the shank top **81** for receiving the shoe contact portion **82** is V-shaped in cross-section. The contact portion **82** is shown secured in the V-shaped top **81** in a position tilted from the longitudinal plane of the shank stem **83.**

FIG. **9** illustrates a work shoe generally designated by the numeral **90** wherein the top **91** of the shoe shank **92** and the contact portion **93** adhesively secured thereon are arranged to define a V-shape for cradling a workpiece.

Throughout the specification and drawings the centerless grinding machine **10** has been referred to and illustrated for the external grinding of a workpiece. However, the machine **10** can also be utilized to accomplish internal grinding of a workpiece by a rearrangement of the grinding medium without departing from the spirit of the invention relating to the work support shoes.

Although we have herein described our invention in what we have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of our invention.

We claim:

1. For use in a centerless grinding machine having a grinding wheel, a plate secured to a frame of the machine in general alignment with the circumferential grinding surface of said wheel and extending transversely with respect to the wheel axis, said plate being adapted to be in alignment with a workpiece to be ground by the wheel, chuck means to hold the workpiece between said plate and said wheel in the grinding position, said plate being adapted to extend generally laterally and downwardly of the workpiece in the grinding position, support arms adjustably mounted on said plate and having inner ends adapted to extend toward the workpiece in the grinding position, work support shoes having outer ends adjustably mounted to respective inner ends of said support arms;

the improvement comprising:

said work shoes each having a workpiece contact portion and a shank portion,

each shank portion having an outer and an inner end, said outer ends of said shank portions defining the outer ends of said work support shoes,

each shank portion being made of a phenolic base material having sufficient degree of flexibility to dampen vibrations imparted to its outer end by the grinding machine during the grinding operation whereby vibration of the inner end is substantially eliminated,

each contact portion being mounted on an inner end of a respective shank portion,

the periphery of the inner end of the shank portion being at least substantially coextensive with the periphery of the contact portion, and each contact portion having an inwardly facing surface arranged for contacting and supporting the workpiece,

said contact portion being made of a high density, low porosity, wear resistant ceramic material.

2. The invention according to claim **1** in which:

said contact portion is secured to said shank portion by an epoxy resin adhesive.

3. The invention according to claim **2** in which:

the inner end of the shank portion and the part of the contact portion secured thereto are shaped to interfit.

4. The invention according to claim **3** in which:

said shank portion has a T-shaped cross section, the outer end of the shank portion terminating at the lower end of the T leg and inner end forming the T crossbar,

said contact portion forming an upper portion of the T crossbar.

5. The invention according to claim **4** in which:

the shank portions have substantially rectangular surfaces between the inner and outer ends.

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