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Dunn

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[54] **WORKPIECE RETAINER ASSEMBLY FOR DISC GRINDERS**

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[52] **U.S. Cl.** ..... **51/237 T,** 51/118, 269/113

[51] **Int. Cl.** **B24b 7/04**

[58] **Field of Search** ..... 51/118, 131, 134, 237 T, 51/217 R; 269/111, 112, 113

[56] **References Cited**

UNITED STATES PATENTS

1,197,436	9/1916	Brightman	269/113 X
1,528,993	3/1925	Samuel	51/134 X
1,990,002	2/1935	Schafer	51/134
2,988,861	6/1961	Vanstrom	51/217 R
3,382,622	5/1968	Dunn	51/131 X

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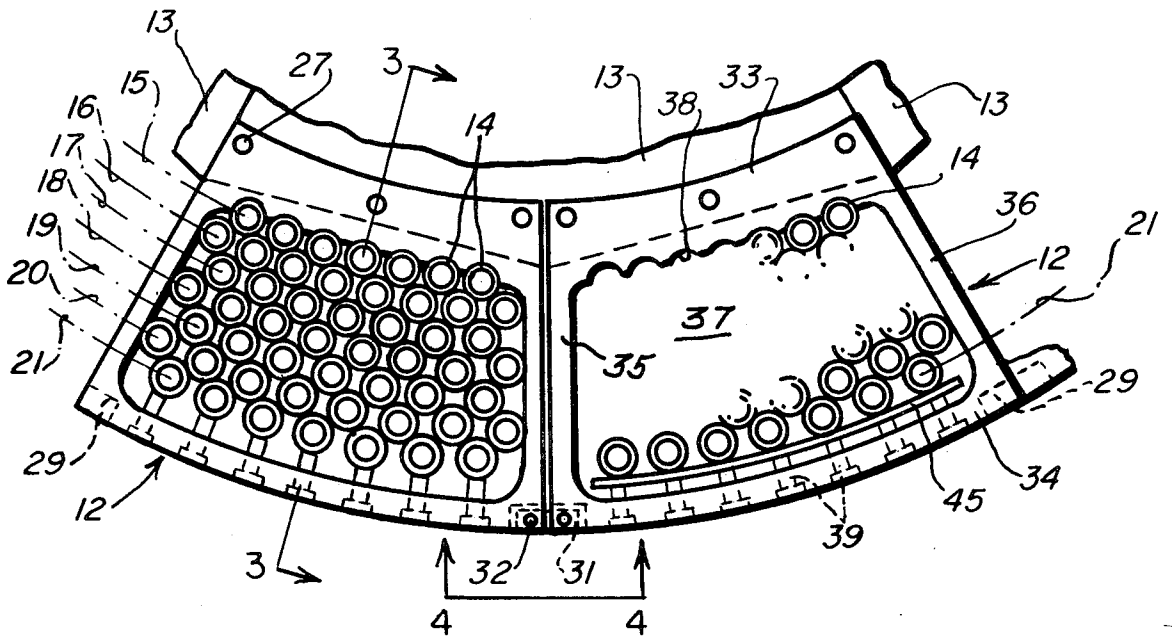
[57] **ABSTRACT**

An annular array of workpiece retaining frame assemblies are mounted on a rotary work carrier for advancing a multiplicity of workpieces, such as coiled compression springs, between one or more pairs of abrasive discs. The work carrier comprises a series of equal segments each of which supports a pair of arcuate workpiece retaining frame assemblies. Each assembly comprises a frame which lockingly embraces a number of work retaining elements or bushings in rows concentric to the carrier axis thereby to carry a maximum number of workpieces, of given diameter within a given annular area. Locking is accomplished by a series of spaced clamping screws in an arcuate peripheral frame wall which serve to force the total complement of bushings into tangential interlocking contact with each other and toward a rigid arcuate inner frame wall provided with locating depressions. The peripheral frame wall and the walls connecting the arcuate walls are made capable of flexure and the clamping screw force applied is such that the peripheral outer wall bows and the radial side walls of each frame are drawn toward each other when the clamping screws are tightened, and contribute to the clamping action or locking up of the workpiece retaining elements.

3 Claims, 5 Drawing Figures



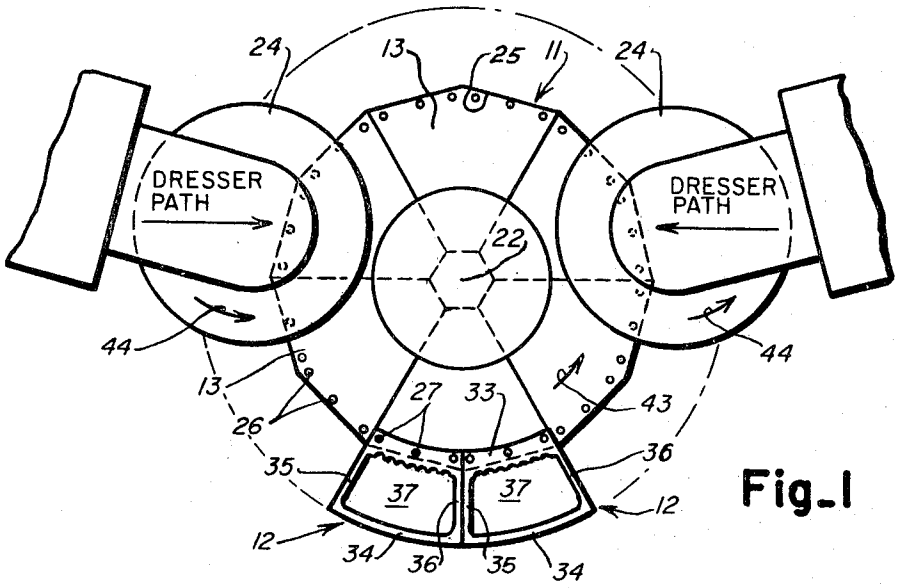


Fig_1

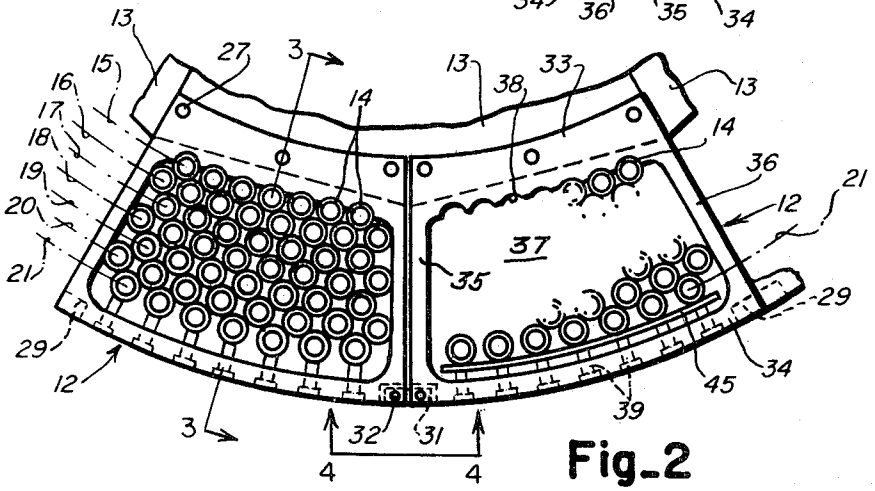


Fig_2

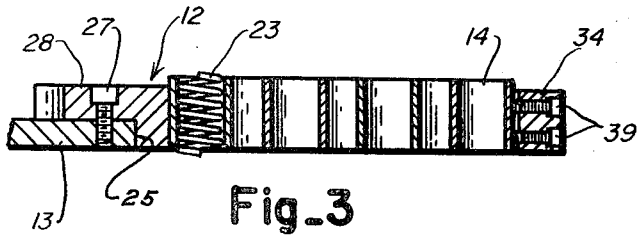


Fig_3

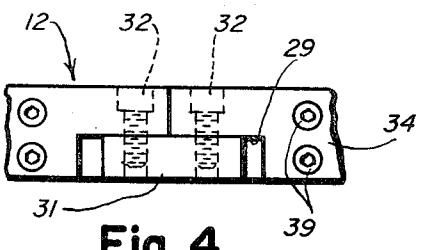
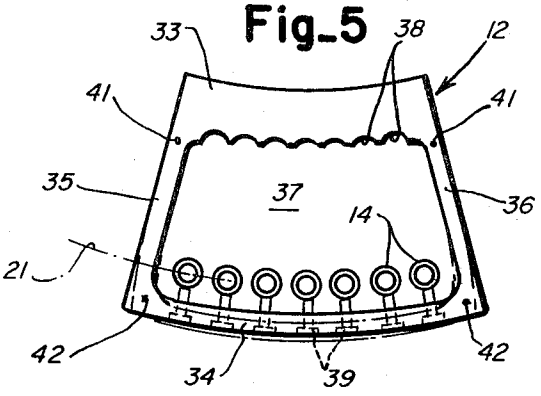


Fig_4

Fig_5



WORKPIECE RETAINER ASSEMBLY FOR DISC GRINDERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to an improved workpiece retaining assembly mountable on a rotary work carrier for advancing a multiplicity of workpieces between one or more pairs of abrasive discs on a vertical spindle surface grinder. The invention has special application in grinding the ends of coil springs or the ends of cylindrical workpieces at maximal production rates.

2. Description of the Prior Art

An early method of grinding opposed ends or faces of workpieces such as coil springs was accomplished by rotating a circular work carrier having perimetral openings for receiving and advancing workpieces between the cutting surfaces of opposed abrasive discs which were rotatably mounted on opposite sides of the work carrier. All of the openings in the work carrier were formed on a common radius, and each workpiece was advanced sequentially, one at a time, in response to rotation of the work carrier. Such a method is disclosed in U.S. Pat. No. 1,371,854, granted Mar. 15, 1921.

A progression of improvements in the design of rotary work carriers and disc grinders occurred due to increased production demands. Segmental work carriers were designed with bored holes to hold several radially spaced rows of workpieces. Such a method is disclosed in applicant's U.S. Pat. No. 3,458,957, granted Aug. 5, 1969, and discloses, inter alia, two sets of grinding discs arranged on opposite sides of the path of movement of the workpiece.

It is well known in the grinding art that the tooling or workpiece holding or retaining element, such as holes or bushings for coiled compression springs, is dictated by the diameter and the length of the springs to be ground. Tubular holders or bushings are employed to loosely hold the springs when the length of the springs exceeded the thickness of the carrier or carrier holder. Too, rotary work carriers have been designed with openings to mount workpiece retaining frames which contained a series of rectilinear fixedly spaced bored holes in an offset manner to support as large a number of coil spring workpieces as possible within a given area. Further, other attempts to increase production called for filling trapezoidal-shaped openings in frames mountable on a work carrier with loose bushings to utilize all the area within the frame. This last arrangement required a time-consuming clamping arrangement to provide an ordered arrangement as the loose bushings assumed random arrangements when placed in the frame. To maintain an ordered arrangement a plurality of clamping screws were required on at least three sides of the frame to assure tangential pressure contact between the loose bushings. Notwithstanding, the production increase was only minor, considering the setup time to provide the necessary clamping action.

SUMMARY OF THE INVENTION

In accordance with the present invention, there are provided for use in a disc grinder which includes two sets of grinding discs arranged on opposite sides of a path of movement of the work carrier, workpiece holding or retaining frames adapted to be carried by each segment of a rotary work carrier. Each frame comprises an arcuate section of an annular array and each frame has one rigid and other flexible walls formed and arranged to lock a multiplicity of loose hardened bushings in concentric circular rows, for supporting, in turn, a like number of coil springs. The geometry of the frames and the flexure of the side walls as a result of clamping forces on the bushings and the frames permit locking of the bushings on application of force from one side only of the frame. Each workpiece is arcuately advanced between the sets of grinding discs by slow rotation of the work carrier to effect the grinding of each end of the coil springs at high production rates.

In a preferred embodiment, each workpiece retaining frame includes an opening bounded by a first inner and a second outer spaced arcuate surface both of which are concentric with the center of the work carrier. The inner arcuate surface is defined by a rigid inner arcuate wall and the outer arcuate surface by an outer arcuate wall. The opening is also bounded by the inner surfaces of straight side walls preferably colinear with radii of the work carrier to define the sides of the opening. One side of each retaining frame is located parallel to one side of a carrier segment when a pair is mounted thereon. The inner arcuate surface of the opening, according to bushing diameter, includes a row of partial circular locating grooves or depressions which are evenly spaced to locate a row of loose workpiece retaining bushings concentric with the center of the work carrier. A plurality of additional rows of bushings outwardly of the carrier center are each offset from the preceding row to obtain tangential contact in all angular directions between each bushing and with the perimeter walls of the opening of the retaining frame. A series of clamping screws carried by the outer wall of the frame and located, according to the bushing diameter employed, in alignment with each bushing in the outer row of bushings, is adjusted to effect a tangential clamping force between each bushing. After the screws are brought into contact with the outer row of bushings, and tightened further, as the inner wall is rigid the outer peripheral wall gives or flexes under the reactive force and bows out radially, thus causing the side walls to draw in about the inner corners of the frame. Thus, the reactive force in a outwardly radial direction and the resilience of the side walls cause them also to be drawn toward one another by the force exerted by the adjusting screws to contribute an inwardly acting, along rows, holding force through the bushings in contact therewith. Therefore, according to bushing diameter, the maximum number of workpieces may be contained within a given arcuate area of a retaining frame, which when duplicated by a plurality of arcuate workpiece retaining frames about the work carrier, enable a maximum number of coil spring ends or other workpieces to be placed in an annular array to be ground for each revolution of the rotary work carrier, thus to obtain maximum production rates.

It is, therefore, an object of the present invention to provide an improved workpiece retaining frame assembly which enables maximum utilization of a given annular space to permit the emplacement of a maximum quantity of work retaining bushings and workpieces on a rotary work carrier of a given size.

A further object of the invention is to provide a workpiece retaining frame assembly with an opening formed to receive, locate and lockup a plurality of loose bush-

ings in concentric circular paths, to thereby accommodate a maximum number of workpiece retaining bushings of a given size.

Another object is to provide a simple manner of holding loose bushings in concentric rows in a frame by application of forces in a generally radial direction as will bring the total complement of the bushings into intimate tangential contact aided by concentric confining forces set up in the frame by said radial forces.

The above and other features and advantages of the present invention will become better understood from the detailed description of the invention that follows when considered in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view showing elements of a vertical spindle disc grinder to illustrate the relative position of the grinding discs, a work carrier, and workpiece retaining frame assemblies for holding a multiplicity of workpiece retaining bushings;

FIG. 2 is an enlarged plan view showing in greater detail workpiece retaining frame assemblies and the clamping arrangement for securing a multiplicity of workpiece holding bushings in circular concentric rows.

FIG. 3 is a sectional view taken along lines 3—3 of FIG. 2;

FIG. 4 is an edge view taken along lines 4—4 of FIG. 2; and

FIG. 5 is an exaggerated schematic view illustrating flexure of the workpiece retaining frames as a result of radially applied forces by the clamping screws.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing in detail, there are schematically illustrated in FIG. 1 elements of a vertical spindle disc grinder, details of which may be found in applicant's U.S. Pat. No. 3,458,957. In the present invention a rotary work carrier 11 is adapted to mount a pair of workpiece retaining frames 12 in each sector or segment 13 thereof. The retaining frames 12 are adapted to lock a multiplicity of hardened loose bushings 14 (FIG. 2) in interlocking rows 15, 16, 17, 18, 19, 20 and 21 concentric with the center 22 of the carrier for supporting a like number of compression coil springs 23 (FIG. 3) or other workpieces to facilitate the grinding of opposite faces of the workpieces 23 simultaneously at high production rates.

Details of the mounting of pairs of grinding discs 24, which are rotatably mounted on vertical spindles, may be found in U.S. Pat. No. 3,018,589, granted Jan 30, 1962.

The work carrier 11 is also conventionally driven about the vertical axis 22 to effect rotation of the sectors or segments 13. FIG. 1 shows an arrangement having six equal sectors 13, with each sector 13 having an outer edge 25. Threaded holes 26 are provided adjacent the edge 25 of the carrier sectors 13 to receive support screws 27 (FIG. 3) extending through an overlapping edge 28 of the workpiece retaining frames 12 so that they may be individually removably secured to a carrier sector 13. Each of the adjacent workpiece retaining frames 12 are undercut as at 29 (FIG. 4) to accommodate strap members 31 which bridge adjacent frames so that they may be secured together by screws 32 to add increased stability. When mounted, the frames 12 carry a substantially continuous annular path of workpieces 23 through the zones of the grinding discs 24 (FIG. 1) when the carrier 11 is rotated.

As viewed in FIG. 2, each of the frames 12 is defined by an inner relatively thick rigid arcuate wall 33, concentric with the carrier axis 22, an outer arcuate wall 34 of thinner dimension than the inner wall 33, and side walls 35 and 36 colinear with radii of the rotary work carrier 11. Thus, an opening 37 defined by the inner perimeter of the frame walls is provided to receive the hollow cylindrical bushings 14. The outer arcuate wall 34 and the side walls 35 and 36 are thinner relative to wall 33 as to be capable of flexure as will hereinafter be made clear.

A plurality of equally spaced partially cylindrical grooves or depressions 38 are formed in the inner side of arcuate wall 33 complementary in shape to bushings 14 to locate the hardened bushings 14 in the inner concentric row 15. The size of the grooves 38 will, of course, depend upon the diameter of the bushings 14 which in turn is determined by the diameter of the workpiece 23 which is to be carried within each bushing 14.

The outer arcuate wall 34 mounts a plurality of double rows of preferably radially directed clamping screws 39 to apply pressure to the outer row 21 of bushings 14. The opening 37 (FIG. 2) is also filled with the additional concentric rows 16, 17, 18, 19, and 20 of the bushings 14. Each row of bushings 14 is offset from the preveious row of bushings 14 with the result that the bushings 14 are in interlocking tangential contact with one another and with the inner wall surfaces of the openings 37. Bushings in alternate rows will be radially aligned when the inner surface of the side walls 35 and 36 are along radii of the work carrier 11. All of the bushings 14 are thus locked in the opening 37 during the set-up operation by the double rows of clamping screws 39 in the outer wall 34 of the retaining frames 12.

The clamping screws 39 are angularly spaced to contact each bushing 14 in the outer concentric row 21, preferably radially, to effect a clamping force which acts throughout the total complement of the bushings 14 to ensure intimate bushing to bushing and bushing to inner frame wall contact. With reference to FIG. 5, tightening or increasing the force of the screws 39 further will cause wall 34 to bow outwardly as shown in dotted lines with the result that the radially disposed side walls 35 and 36 will be drawn inwardly about pivots adjacent their point of connection to inner and outer walls 33 and 34, as at 41 and 42 respectively. This side wall flexure contributes an additional concentrically directed holding force against bushings 14. Thus, clamping screws are necessary in only one wall and each bushing 14 will be held in equilibrium with equal force sufficient to prevent any undesired movement of the bushings 14 when the ends of the workpieces 23 therein are being ground.

As is conventional, a support plate (not shown) will underly the work carrier 11 except where openings are provided to permit the grinding discs 24 to be adjusted vertically to provide the desired amount of stock removal during the grinding operation when the work carrier 11 is rotated. Also, an additional opening is provided in a conventional manner to permit the workpieces 23 to be discharged by gravity at a discharge sta-

tion. Further, a loading station is provided at the front of the machine in a conventional manner. As is known, the above noted support plate acts as a guide as the workpieces **23** traverse an arcuate path between the grinding discs **24.** The work carrier **11** is rotated at a rate slow enough to permit an operator to place a workpiece **23** in each of the bushings **14.** However, this invention will also permit an automatic work loader (not shown) to be used, since the position of each workpiece **23** will be constant for each retaining frame **12** for particular workpiece sizes.

The carrier assembly **11** is normally rotated in a counter-clockwise direction as shown by the directional arrow **43** in FIG. **1,** and the opposed pair of grinding discs **24** are always rotated in the same direction, indicated by arrow **44,** to ensure that a workpiece **23** will rotate or spin at a rapid rate during grinding in a conventional manner.

The above arrangement permits the maximum number of workpieces **23** to be contained within a given area of each frame opening **33** and, therefore, the production capacity for a single rotation of the work carrier **11** will be increased.

It is also possible to utilize a bushing clamp strip **45** (FIG. **2**) between the outer concentric row **21** of bushings **14** and the ends of the clamping screws **39** so that the clamping screws **39** do not bear directly against the bushings **14.**

As in prior art grinders the removable retaining frames **12** will reduce the set-up time prior to a dressing application, as only one retaining frame **12** need be removed for dressing each grinding station. The bushings **14** will remain locked in the retaining frame **12** during a dressing operation, and the retaining frame **12** is easily replaced at completion of the dressing operation.

It should be understood that although the preferred embodiment of this invention has been applied to a vertical disc grinder having a rotary work carrier assembly, a similar retaining frame (not shown) could be utilized on a gun-type carrier such as disclosed in applicant's U.S. Pat. No. 3,503,155, granted Mar. 31, 1970. The retaining frame would be advanced and retracted from the grinding zone by movement of the gun-type carrier.

It is also to be understood that only a preferred embodiment of the invention has been specifically illustrated and described, and variations may be made thereto without departing from the invention, as defined in the appended claims.

The invention claimed is:

1. A workpiece carrier for a machine tool comprising

at least one workpiece retaining frame including connected rear, front and side walls defining an opening therein,

a pluarlity of cylindrical workpiece receiving bushings located within said opening with the axes thereof extending in a single outward direction with a predetermined number of said bushings lying proximate said front wall, and

a corresponding plurality of individually, incrementally advanceable clamping means secured to said front wall and selectively located adjacent said predetermined number of bushings lying proximate said front wall,

said corresponding plurality of clamping means being individually incrementally advanced into clamping engagement with said corresponding bushings with collective force sufficient to draw said side walls inwardly and to bend said front wall outwardly thereby assuring that each one of said plurality of workpiece receiving bushings located within said opening will be fixedly clamped within said frame.

2. A workpiece carrier for a machine tool according to claim **1,** further comprising a force transmitting member intermediate said bushings and said plurality of clamping means.

3. A workpiece carrier for a machine tool according to claim **2,** wherein said rear wall includes a plurality of depressions selectively located to receive a predetermined number of said bushings lying proximate said rear wall.

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