

[54] **WORK HOLDER**

[72] Inventors: **Harry G. Stevens**, 1029 Terracewood Drive, Englewood, Ohio 45322; **Robert Earl Smith**, 4224 Scrubb Drive, Kettering, Ohio 45429

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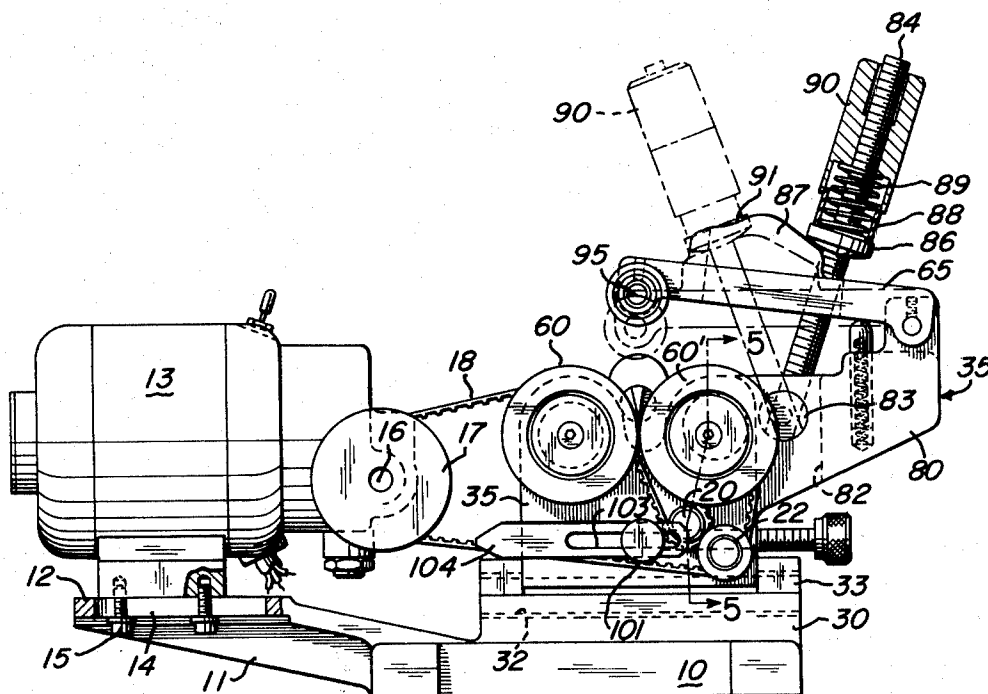
Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Jerold M. Forsberg
Attorney—Jerome P. Bloom

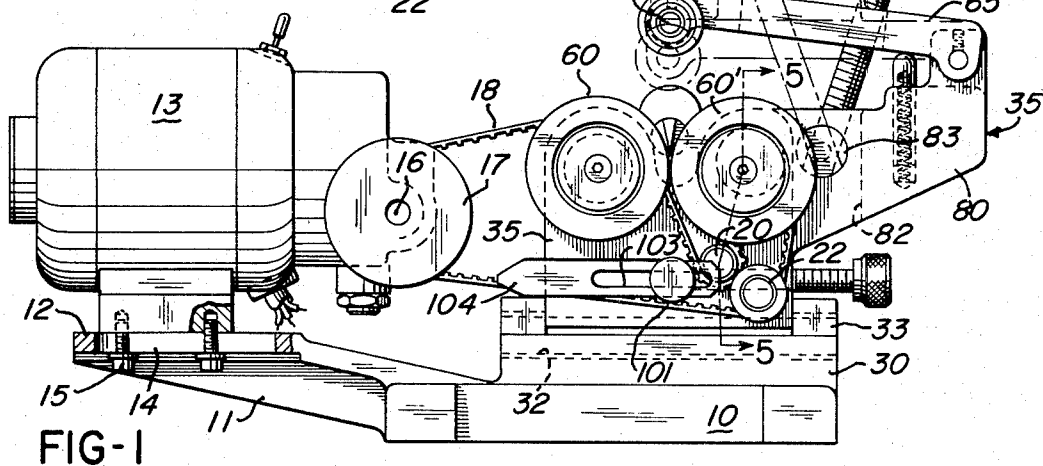
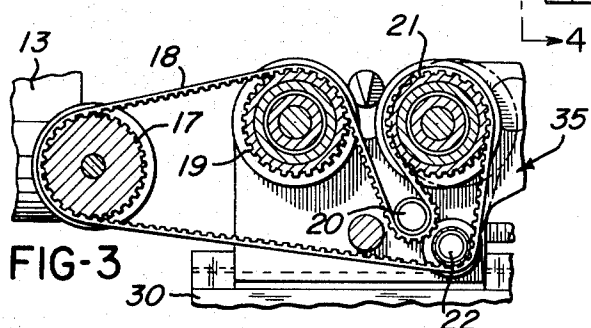
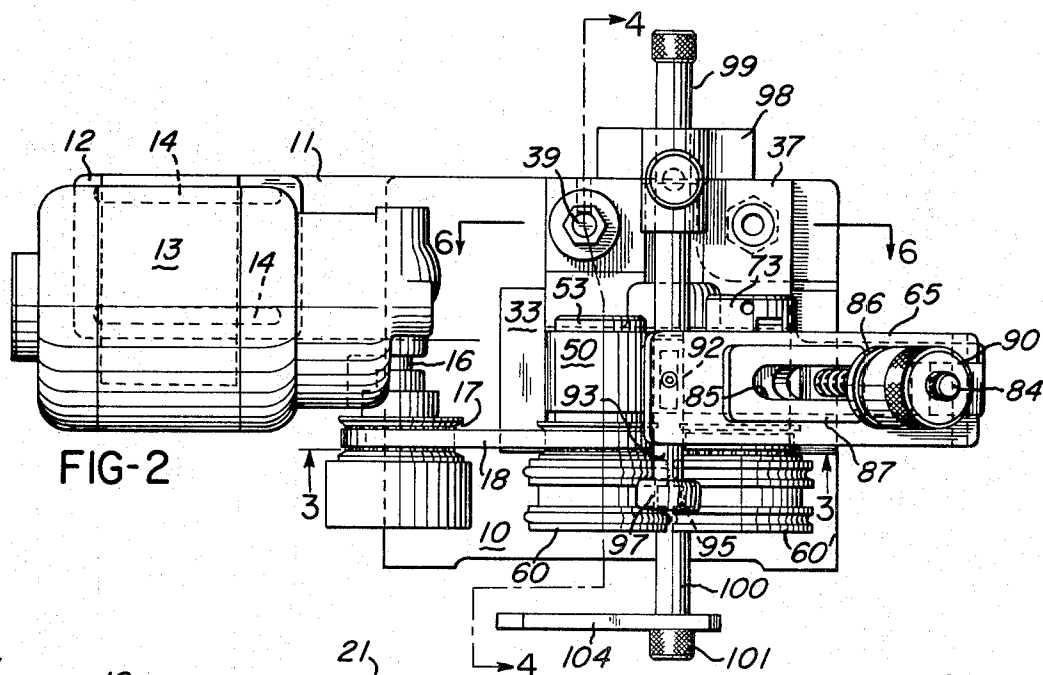
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ABSTRACT

A work holder capable of holding a work piece having a generally arcuate circumferential body portion, to give location, baring, and rotating support to said body portion while presenting another body portion of said work piece for grinding and like operations. The invention device features simplified and improved holding means including unique roller modules which per se incorporate their drive means and have simple means adapting them to mount various size work pieces without loss of efficiency. It also provides a continuous drive system for such modules distinguished by precision control means affording a maximum use of applied power. It is further characterized by the application of O-rings to at least one roller module in a manner to exert a balanced and positive rotative influence to the workpiece. Means are provided to precisely reference a work piece to a cutting tool and to simply induce an angular disposition of or apply an axial driving force to a work piece during a cutting operation.

18 Claims, 10 Drawing Figures





INVENTORS
HARRY G. STEVENS
ROBERT EARL SMITH

BY *Jessie P. Bloom*
ATTORNEY

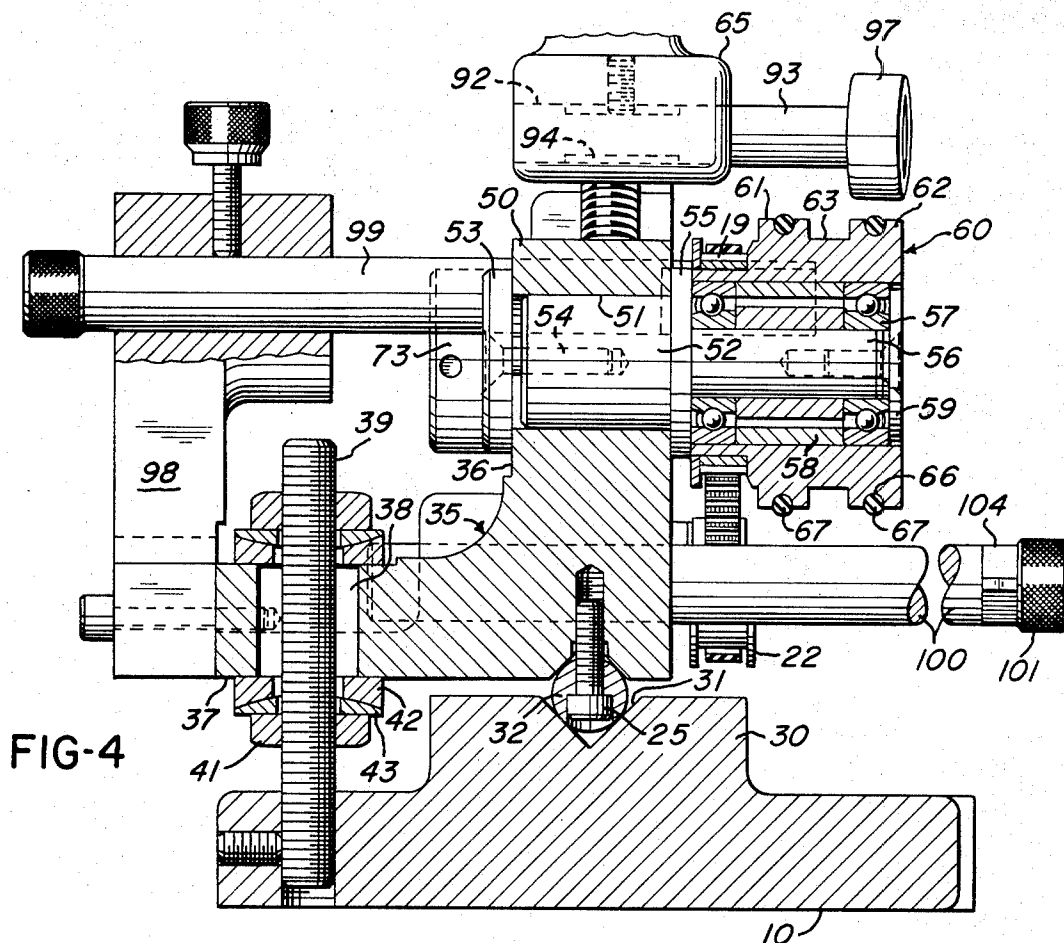


FIG-4

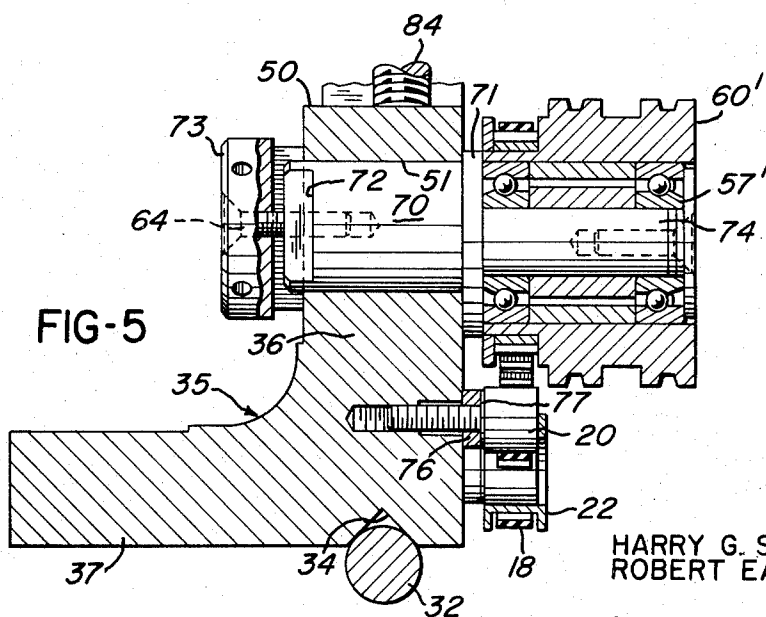
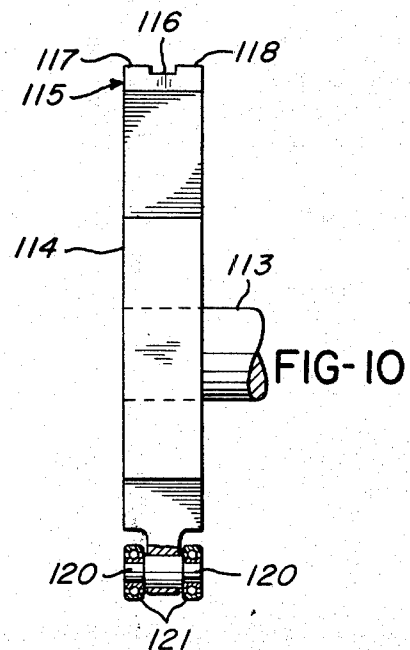
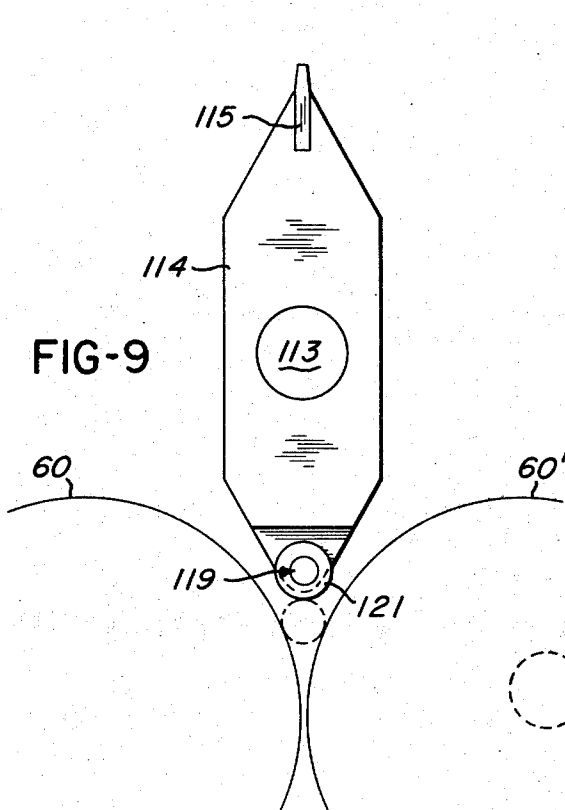
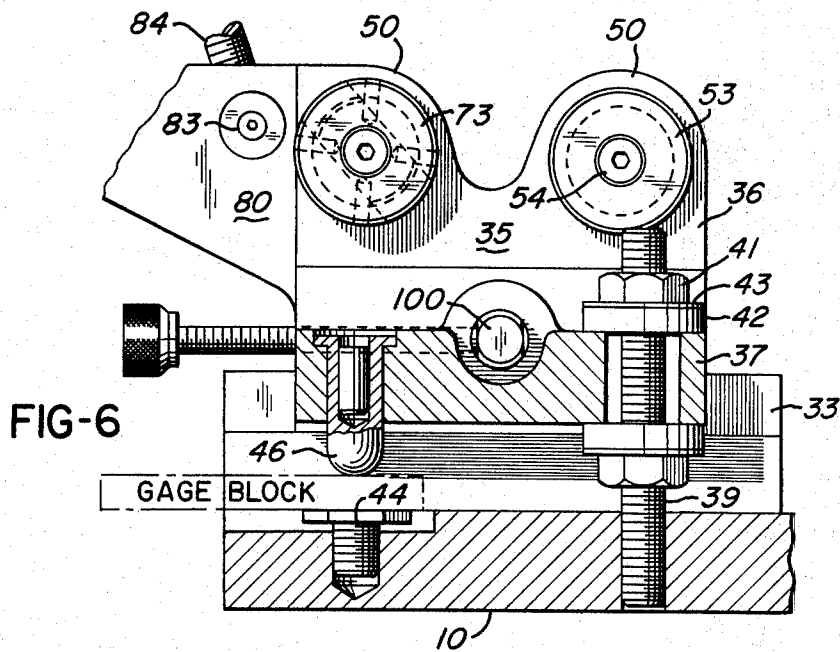


FIG-5

INVENTORS
HARRY G. STEVENS
ROBERT EARL SMITH

BY *Jerome P. Bloom*

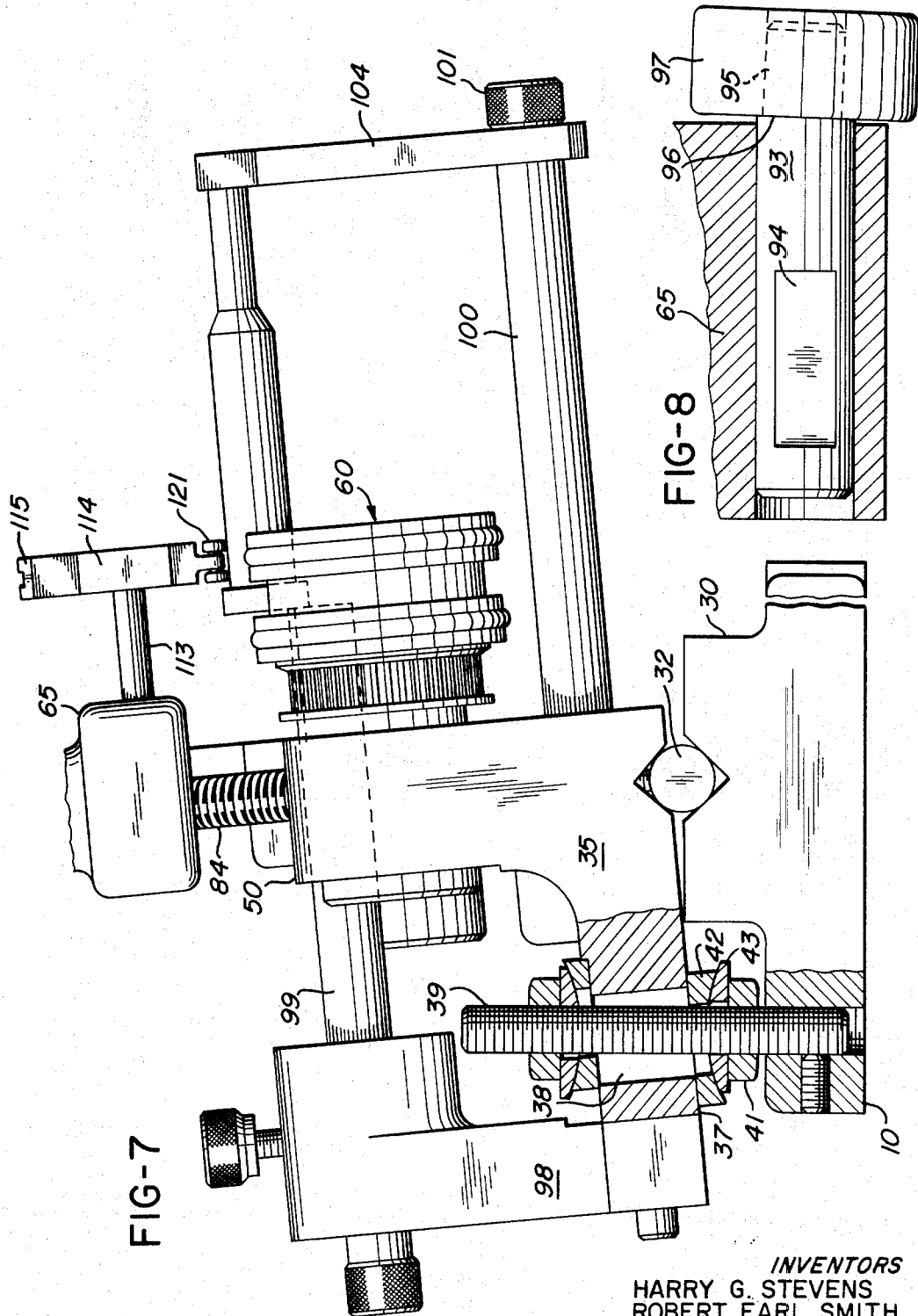
ATTORNEY



INVENTORS
HARRY G. STEVENS
ROBERT EARL SMITH

BY Jerome P. Bloom

ATTORNEY



WORK HOLDER

BACKGROUND OF THE INVENTION:

This invention is directed to the simplification and improvement of work holders with a view to rendering them move versatile in use and more efficient and satisfactory for a wider variety of applications. It is particularly advantageous in application to fabricating and maintaining punches and like tools or products distinguished by a generally rod or cylinder form in the first instance and will be so described, though not so limited in application.

Many work holders have been designed heretofore for holding objects of small character and variable length which must at the same time be driven at high speed to be either worked on themselves or applied to produce work on other objects. There are a multitude of such devices subject of prior patents such as, for example, the Gargrave U. S. Pat. No. 3,145,861. Each patent of this nature has directed its attention primarily to means and methods of holding, rotating, and driving small diameter work pieces by roller means of various design and with a view, in most cases, to enable an inter-nesting relation of the roller means to achieve the control of the work piece. The prior art devices have had varying degree of success but no one has shown as great a versatility as required or desired for the multitude of present day applications which present themselves in a single fabricating installation. Moreover, their ability to achieve precision results and to operate with maximal use of applied power and a minimum of attention generally has not been proven in practice.

DESCRIPTION OF THE INVENTION

It is a primary object of the present invention to overcome the general deficiencies in prior art work holders for the purposes described to achieve, in an economical fashion, one which is more efficient and satisfactory in use, adaptable to a wide variety of applications and susceptible of operation substantially without occurrence of malfunction.

Another object of the invention is to provide an improved work holder capable of use to insure precision results.

A further object of the invention is to provide a unique roller module for work holders.

An additional object of the invention is to provide an improved arrangement for mounting a work piece of, at least in part, a cylindrical body form for rotation about its longitudinal axis for work to be done on or by a projected portion thereof, said arrangement incorporating means for a variable precision orientation of the projected portion of the workpiece.

Another object of the invention is to provide a work holder for the use described possessing improved driving control means for rollers supporting thereon a work piece.

A further object of the invention is to provide a rotating mount for work pieces having simple means for varying their relative disposition to selectively accommodate the work piece as to its size, desired attitude and character of movement for work thereon or thereby.

Another object of the invention is to provide improved holding means for containing a work piece to a mount inducing the rotation thereof for work to be done thereon or thereby.

An additional object of the invention is to provide a work holder possessing the advantageous structural features, the inherent meritorious characteristics and means and mode of use herein described.

The embodiments of the invention here illustrated comprise a simple base including to one end an offset arm mounting a drive motor geared to directly drive, preferably through one continuous belt, unique roller modules which mount a work piece. One roller module mounts eccentrically of a rotatable shaft, a simple adjustment of which is sufficient to accommodate the application to said roller modules of work pieces of various diameter. The roller modules commonly mount to a tiltable bracket capable of precision adjustment to orient the axis of a work piece as desired. The same bracket mounts a lever embodying a third element for containing a work piece to the roller modules under a variable selected degree of compression. The roller modules incorporate, in at least one instance, resilient O-rings designed to produce a most positive drive and balanced control of the work piece in effecting its rotation. Unique means are also provided to achieve, in a simple fashion, a taper on a work piece and/or an axial movement of a rotating work piece as held to and driven by the inventive structure.

The above noted features as well as others provided by the invention and their structural detail will become self evident from the following illustrations of preferred embodiments.

With the above and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter described or illustrated in the accompanying drawings, or their equivalents.

Referring to the drawings where some but obviously not necessarily the only forms of embodiment of the invention are shown:

FIG. 1 is a front elevation view of a work holder in accordance with the invention;

FIG. 2 is a top view of the structure of FIG. 1;

FIG. 3 is a fragmentary view of the drive system, taken on line 3—3 of FIG. 2;

FIG. 4 is a view taken on line 4—4 of FIG. 2;

FIG. 5 is a view taken on line 5—5 of FIG. 1;

FIG. 6 is a fragmentary view, partly in section, taken on line 6—6 of FIG. 2 and illustrating the tilt controls for the work mounting bracket of the device of FIG. 1;

FIG. 7 is a fragmentary view, partly in section, illustrating the versatility of the work holder in application to the forming or guiding of a punch;

FIG. 8 is a detail of the skew holding roller embodied in the device of FIG. 1; and

FIGS. 9 and 10 illustrate front and side views of a reversible work hold down device which may be applied to the clamping lever for a work piece in lieu of the skew roller illustrated in preceding Figures.

Like parts are indicated by similar characters of reference throughout the several views.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION:

A preferred embodiment of the invention shown in the drawings includes a rectangularly formed base 10. Angled upwardly from one end and to the rear edge of

base 10 is an integrally formed arm 11. The projected extremity of the arm 11 presents an elevated horizontal platform 12 on which is mounted a drive motor 13. Formed in the platform 12 are parallel slots 14 which are oriented parallel to the front edge of the base 10. The slots 14 receive therethrough bolts 15 the heads of which dispose to the underside of the arm 11 and the upper extremities of which are threadedly engaged in the base of the drive motor. The bolts 15 function as conventional clamping devices by means of which the motor 13 can be secured in any desired position which can be accommodated within the limits of movement of the bolts 15 as predetermined by the length of the slots 14. The purpose of this will be further described.

Utilizing conventional means, there is a power takeoff at right angles to the motor drive shaft through the medium of a power transmission shaft 16. The shaft 16 is oriented to project forwardly on the base 10 and has fixed in connection with its projected extremity a toothed gear belt pulley 17. Looped about the pulley 17 is one end of a continuous gear belt 18. The belt 18 extends from the pulley 17 to move in a sense upwardly over a gear belt pulley 19, down around an idler wheel 20, then up over a gear belt pulley 21, down around a centrally channelled belt guide idler wheel 22 and back to the pulley 17. It will be seen from the drawings that the channelled idler 22 has a deep central groove in its periphery and is so positioned and formed that simultaneous with its function as an idler it will nest and laterally contain the belt 18 as it passes under and about the idler 20 to move to the gear belt pulley 21. It will be seen, therefore, that the idlers 20 and 22 have a mating functional relation. As will become evident from a further description of the invention structure, the idlers act commonly to influence not only a proper direction and alignment of the belt 18 at the idlers but throughout the complete run of the continuous belt. The arrangement is such that there will be no slippage of the belt on the driven elements and the belt will be inhibited from lateral travel from the desired plane of its operation. The net result achieved is an optimal driving efficiency and minimal belt wear. As will be further seen, the position and application of the idlers in the invention structure is such that with a relative adjustment of one or more of the gear pulleys that satisfactory belt tension can be easily maintained.

Looking now to the base 10, formed integral with its upper surface is a generally rectangular block-like projection forming a pad 30. In the upper surface of pad 30 and in a line parallel to the plane of the continuous belt 18 is a coextensive V-formed groove 31. The groove 31 nests coextensively therewith a pivot rod 32 which has a uniform diameter. The sizes of the groove 31 and the rod 32 are such that as the rod 32 nests in the groove 31 a diameter thereof positions substantially co-planar with the upper surface of the pad 30. Superposed on each of the respective ends of the pad 30 is a generally rectangular guide bar 33. The bars 33 serve to nest and confine the respective ends of the pivot rod 32, having complementary V grooves 34 in their bottoms to accommodate the same. Extending between and laterally confined by the guide bars 33 is the base of a mounting bracket 35. The mounting bracket 35 has in side elevation a generally right angled configuration, one arm 36 thereof projecting generally vertically of the base 10,

relatively centered over the rod 32 to which it is secured at points spaced longitudinally of the rod by screws 25. As seen in the drawings, the bracket 35 at the base of its arm portion 36, in the area where it is secured to the pivot rod 32, has a shallow channel to partially nest the upper projected surface of the rod.

It will be seen that this channel accommodation of the pivot rod 32 by the undersurface of the bracket 35, in an area thereof adjacent the forwardmost limit of the bracket, establishes a vertical spacing between the base of the bracket and the uppermost surface of the pad 30.

The other arm 37 of the bracket 35 provides what might be considered the base of the bracket, extending generally horizontally and in a sense rearwardly over the base 10. To the rear of the pad 30 and in a corner thereof at an edge most adjacent the drive motor 13, the arm 37 has formed therein an aperture 38. Threadedly engaged in and projecting vertically from a rear corner of the base 10 is a screw 39 which extends upwardly, with substantial clearance, through the aperture 38. The lower end of the screw 39 is fixed against rotation by an appropriately applied set screw. Immediately above and below the arm 37 of the bracket 35 is a set of spherical seating washers, each set being confined in reference to the arm 37 by a nut 41 on the screw 39. As will be evident from the drawings, the elements of each set of washers comprise a first washer 42 the base of which seats against the adjacent surface of the arm 37 with clearance in respect to the screw 39. The outermost surface of the washer 42 has a recess formed as a segment of a sphere. This recess accommodates a complementarily formed surface on the mating washer 43 of the set. The outermost surface of the washer 43 is flat. It will be readily seen from FIGS. 4 and 7 of the drawing that the bracket 35 may be tilted forwardly or rearwardly with reference to the base 10, to the degree accommodated by the spacing between the bracket and the pad 30, and this tilting can be readily accomplished on loosening of the nuts 41 of screw 39 to permit the relative adjustment of the complementary spherical surfaces of the sets of washers abutting the upper end lower surfaces of the arm 37 within the limits of the nuts 41.

Accordingly, since the bracket 35 has a rotatable base afforded by the pivot rod 32 which is confined for rotation to the base 10, on backing off one of the nuts 41 in accordance with the direction of tilt desired for the bracket 35, one can then turn up the other nut and fix the attitude of the bracket, a firm positioning of the bracket being insured by the use of the spherical seat washers 42 and 43. Of course, a normal and zero setting for the bracket would be where the arm 37 is in a horizontal position.

Note that in the rear corner of the base 10 which is laterally remote from the screw 39, there is screwed a flat headed bolt 44 which may be fixed against rotation in a conventional manner by a locking set screw applied in the side of the base. In accordance with the invention, the head of the bolt affords a plane of reference immediately above the upper surface of the base 10. Immediately above the head of the bolt 44 in a corner of the arm 37 of bracket 35 which is remote from the screw 39, there is fixed in the undersurface of the arm an element providing a spherical projection 46. The projection 46 is arranged so that when the arm 37

is horizontal its lowermost point of projection is generally centered in respect to the planar surface of the bolt head thereunder.

The invention contemplates that a precision gage block may be inserted between the head of the bolt 44 and the projection 46 with the nuts 41 in a backed off condition. By the use of this gage block of precision dimension one can then establish a precise zero setting for the bracket 35, at which point the nuts 41 may be turned on screw 39 to achieve a fixed position of the bracket. As mentioned previously, on backing off one of the nuts 41, one may then apply a precision gage block between the head of the bolt 44 and the projection 46 to achieve a precise and calibrated tilt of the bracket, upon which one can then turn up or down the nuts to fix the calibrated adjustment of the position of the bracket.

As will be seen in further description of the invention structure, when the adjustment of the bracket 35 is to orient it in a "zero" position, a supported work piece will have its longitudinal axis precisely horizontal so that one can grind the same, for example, in any portion thereof with no taper resulting. Correspondingly, a tilting of the bracket from the zero reference position will position a work piece so as to enable and insure a precise taper in a conventional grinding procedure.

It is noted that the invention structure is designed so the dimension from the contact point of spherical projection 46 to the pivot center of the bracket provides a moment arm which is compatible with published standard tables such as those in Machinery's Handbook so that a predetermined gage block applied between the projection and the bolt head 44 will create a predetermined angle of adjustment for a supported work piece.

At the upper end of the vertical arm 36 of the bracket 35 are laterally spaced co-planar projections 50 each having an identical through aperture 51. The central axes of the apertures 51 are parallel and run directly from front to rear of the base 10. The aperture 51 in the projection 50 most adjacent the motor 12 receives therein an enlarged diameter portion of a shaft 52 having a tapped recess in the end thereof to the rear of the bracket arm 36. To the rear of shaft 52 the aperture 51 in which it seats is capped by a retainer plate 53 including a central opening through which is passed the body of a screw 54 to be threadedly engaged in the tapped recess in the adjacent end of the shaft 52. The enlarged portion of the shaft 52 which nests in the aperture 51 terminates immediately forward of the projection 50 in an external flange 55. Accordingly, when the enlarged portion of the shaft 52 is inserted in the forward face of the projection 50 to enter its accommodating aperture 51 and the retainer plate 53 and screw 54 applied to the rear of the projection, on engaging and fixing the screw the flange 55 will be drawn into an abutting relation with the adjacent projection 50 and the shaft is thereby fixed to the arm 36. The shaft 52 includes a reduced diameter portion 56 which projects forwardly of the flange 55 and perpendicular to the forward face of the adjacent projection 50.

Slip fit on the reduced shaft portion 56 are a pair of precision matched roller bearings 57 spaced by a complementary spacer 58, the assembly of which is contained to the shaft flange 55 by application to the outermost end of shaft portion 56 of a retainer plate 59

secured to the projected end of the shaft portion 56 by a screw. The bearing assembly thus defined mounts coextensively therewith a roller module 60. The module 60 has a sleeve form and immediately adjacent the flange 55 which it abuts it is substantially reduced in external diameter to accommodate and fixedly mount thereabout the gear pulley 19. The latter is contained to a shoulder formed by the reduction in external diameter of the inner end of the module by a bearing retainer plate, means being provided so that the pulley is integrated with the roller module. Outwardly of the external toothed gear pulley 19 the relatively thicker body portion of the module sleeve 60, the interior diameter which is uniform, has formed on the exterior thereof longitudinally spaced, circumferential radial projections 61 and 62. The projection 62 is coincident with the outer extremity of the module. The projections 61 and 62 define therebetween an annular channel 63. There is formed centrally and circumferentially of each of the projections 61 and 62 a shallow groove 66 which has a modified "V" form, the side walls of the V converging at inclinations of about 15° to terminate at a flat base which forms a truncated apex on the V. Each of the grooves 66 accommodate the circumferential seating therein of a resilient O-ring 67. In accordance with a preferred concept of the invention the grooves 66 are of a size and depth which are proportioned to the sectional diameter of the applied O-ring 67 so that the surface of the O-ring extends above the diameter of the roller module by a controlled amount, preferably approximately 0.010 inches. It is noted that the shape of the groove 66 is significant in that the modified V form of its cross section provides space for the O-rings to deform radially instead of circumferentially. As a result, in use of the O-rings, as will be further described, there is a substantial reduction of the circumferential creep which would occur otherwise. The consequence of this is a decrease in wear of the O-rings and a substantial lengthening of their effective operating life.

The vertical projection 50 of bracket 35 most remote from the drive motor 12 has rotatably nested in the aperture 51 thereof a rear segment of a shaft 70 including a radially projected external flange portion 71 which abuts the forwardmost face of the bracket arm 36. Adjacent the rear of the arm 36, the one end of the shaft 70 is provided with diametrically opposite flatted sides 72. This rear end of the shaft 70 which projects from the bracket arm 36 nests in a complementary shaped recess in a control cap 73. The control cap is secured to the shaft 70 by a screw 64. The arrangement is such that the portion of the shaft 70 between flange 71 and the control cap is rotatably mounted in the bracket arm 36, the rotation being possible through the medium of a rotation of the cap 73 as will be further described. Forwardly of flange 71 the shaft 70 has a reduced diameter portion 74 which projects in eccentrically offset relation to the axis of the portion of shaft 70 which is rotatably mounted within the bracket arm 36. The reduced diameter eccentric projection 74 has contained thereon an assembly of matched bearings 57' of a nature and contained in a manner as bearings 57 on the shaft segment 56. Moreover, rotatably mounted on this bearing assembly is a roller module 60' identical with that previously described. It is noted

that in some cases it may be preferred that the grooves 66 be eliminated to present smooth circular exteriors on the projections 61 and 62. Of course, in such case the O-rings 67 will be eliminated also. However, in this instance it is preferred, as illustrated, for simplicity of manufacture, that the roller modules 60 and 60' be identically formed. Of course, this enables interchangeability of parts, a desirable feature. In the case of the roller module 60', the gear belt pulley thereon will correspond here to the pulley 21. Since the pulleys 60 and 60' are identical in substance, it would appear that no further detail of the pulley 60' is necessary, except to note in the preferred embodiment it requires no O-rings.

Noting the drawings, directly below and to the left of center of the last mentioned roller module there is anchored in and perpendicularly projected from the forward face of the bracket 35 a bolt-like device which mounts immediately adjacent and in abutting relation to the bracket a spacer 76, a washer 77 and the idler 20 which rotatably mounts thereon. Of course, a suitable washer is provided adjacent the head of the bolt and to the outer face of the idler roller so it may turn freely in respect to the pivot which is provided therefor by the bolt.

Immediately below and to the right of the pivot for idler 20 the bracket 35 has in connection therewith a pivot for the idler 22. With particular reference to the showing in the drawings, it is again noted that in the periphery of idler roller 22 is a deep circumferential channel of a width to accommodate the movement of the gear belt 18 thereunder in an area diametrically opposite the location at which another portion of the belt passes under the idler roller 19. It will be seen that the idler roller 22 is positioned to nest the portion of the belt passing under and up from the idler roller 19. In this manner, there is a dual vertically spaced control of the continuous gear belt 18 to insure its precision location and optimal control for best driving efficiency in respect to the elements with which it is interengaged.

Attention is directed to the fact, once more, that by a mere rotation of the cap 73, the shaft 70 which is connected therewith may be rotated to variably position its forwardly projected eccentrically disposed extension and thereby move the roller module which mounts thereon to and from the adjacent module which has a relatively fixed position of its axis as defined by the mounting shaft portion 56.

Projected upwardly and to the side of the bracket 35 remote from motor 12 is an integrally connected arm 80. Pivoted to the projected extremity of the arm 80 and reversely directed to overlie the same is a lever 65. Formed in the arm 80 intermediate its ends is a vertical through slot 82 which in opposite side wall portions most adjacent the end immediately forward of the pivot for the arm 65 has aligned apertures. The latter accommodate for rotation therein the ends of the pivot pin 83 which disposes in transversely bridging relation to the slot 82 at a location immediately adjacent the module 60' to its side remote from the module 60. The pivot 83 mounts in a sense essentially parallel to the shafts mounting the roller modules and projects through and is engaged to the lower end of a large screw-like member 84. The member 84 projects upwardly in a plane common to the arm 80 and through a slot 85 in

the overlying lever 65. Immediately over the lever 65 the screw-like member 84 mounts thereon a washer 86 spherically contoured on its underside which bears on a pair of cam-like vertical wall sections 87 projected along either side of the slot in lever 65 in a sense at right angles to the shafts or axes of the roller modules. Contained in a sleeve 88 about the screw member 84 above the washer 86 is a coiled spring 89. Spring 89 projects above the sleeve 88 to be contained by a sleeve-like cap 90 the base of which is threadedly engaged by the screw member 84 which projects therethrough. It will be readily seen that as the cap 90 is threaded down about the screw member 84, noting FIG. 1, the cap will telescope about the short sleeve 88 above the washer 86. It is noted that the sleeve 88 has calibrations so one may predetermine the force supplied by a selective adjustment of the cap sleeve 90.

Looking now to the vertical wall projections 87 orienting to either side and the length of the slot 85, at their ends most adjacent the lever pivot the projections are sloped upwardly at an angle to the top surface of the lever of approximately 20° to 40°. From a peak the tops of the wall projections uniformly slope downwardly except for immediately following the peak on the down slope is a latching depression or dimple 91.

At its end remote from its pivot the lever 65 has a transverse through passage 92. At the end of the lever adjacent and forwardly of its pivot, there is mounted in the bracket arm immediately thereunder a spring biased plunger the influence of which is to apply a bias of lever 65 in a sense clockwise about its pivot.

Returning now to the through passage 92 at the projected extremity of the lever, when the lever is in a depressed position wherein it assumes a substantially horizontal orientation, the central axis of the through passage positions relatively central to the roller modules, in a sense fore and aft of the base 10. Slip fit in the passage 92 to project forwardly therefrom is a pin-like shaft 93 which has in the body thereof diametrically opposite flats 94. In mount of the pin 93, the body portion thereof including the flats 94 is inserted in the passage or aperture 92 to be held by a single set screw engaged through the lever 65 to abut one or the other of the flats 94, depending on which is positioned uppermost. The portion of the shaft 93 which is within the lever 65 has its axis generally parallel to the axes of the roller modules. However, the extremity of the shaft 93 which projects forwardly of and relatively above the roller modules has its exterior surface turned down about an axis angled at 45 minutes to 1 degree to the longitudinal axis of the remainder of the shaft. This angled outer end portion 95 and the way the shaft is uniformly turned down to create this angle produces an angularly inclined shoulder 96. The shoulder dictates the position of a roller 97 which is applied on the angled end portion of the pin shaft 93. By this means, depending on which flat is positioned uppermost to hold the pin 93 in a particular orientation, the angle at which the portion 95 is disposed is directly changed to an opposite position. There is thus provided a telescoping two directional skew roller which may be moved laterally parallel to the longitudinal axis of a work piece held and ground, for example, and maintained at the same angle of skew and still contact the work piece at a

constant radial location. The significance of this will be further described.

Further included in connection with the bracket 35, to its rear horizontal portion is mounted a bearing 98 through which is projected a horizontally oriented rod 99 serving as a rearward stop for a work piece. The stop 99 is axially adjustable and may be secured in any selected position by means of a set screw engaged thereto through its bearing support.

There is also provided immediately over the pad 30 in connection with the bracket 35 and projecting perpendicular to its front face and forwardly thereof a shaft 100. In the center of the projected extremity of shaft 100 is threadedly engaged a screw 101. The screw 101 is a cap-type screw and the body thereof projects through an elongate slot 103 in a bar-like member 104 which is to serve as a front stop member for a work piece. As is evidenced in FIG. 1 of the drawings, on sufficient release of the cap screw in reference to the bar 104, it may pivot about the body of the screw to a position displaced from a work piece. When in use, the cap screw can be released and the bar 104 positioned perpendicular to the base 10 and serve as a front stop for a work piece such as indicated in FIG. 7.

Let us now consider the use of the invention structure above described. For example, if rod stock is to be placed in the work holder to be worked to a punch form, one end thereof may be laid in the nest defined between the uppermost adjacent surfaces of the roller modules 60 and 60'. As laid in, the cap 73 on the shaft 70 may be turned to eccentrically move the shaft portion 74 to a position that the body portion of the work piece or stock of cylindrical form will be optimally nested between the roller modules. In the one case, to one side thereof the so based body portion of the work piece will be in engagement with the projected portions of the O-rings 67 to be resiliently based there against. On the other side the roller module 60' will afford four longitudinally spaced annular bearing surfaces balancing the body of the stock. Disregarding the front and back work stops in this instance, one can then move the arm in the form of the screw 84, its full line position shown in FIG. 1, to its dotted line position. Depending on the dimension of the work piece and the pressure to be applied thereto, the screw sleeve or cap 90 is appropriately adjusted to afford a proper bias through the spring 89 to the spherically contoured washer 86 which bears on the cam surfaces of the projections 87 on the lever 65. It will be readily seen that as the washer 86 is pushed upwardly on the slope of the cams 87, the projected extremity of the lever 65 is caused to be depressed against the bias thereon. As the washer is carried by the screw-like member 84 up over the peak of the cam, the skew roller 97 is caused to bear on an uppermost surface of the body portion of the work piece which is balanced on and between the roller modules 60 and 60'. As the washer 86 moves over the peak of the cams 87, there is a resilient accommodation of any reactive force by the spring 89 and thereafter a relief as the spherical surface of the washer 86 seats in the dimples 91 in the cam surfaces.

Where the axis of the round stock or rod stock is to be maintained horizontal for working a projected extremity thereof which extends beyond the roller modules, the work holder will be oriented as

represented in FIG. 4 of the drawings. This is the zero position which has been appropriately established as illustrated in FIG. 6. Here it is shown that a gage block precision form to indicate a zero position is placed over the flat head of the bolt 44 and with the nuts 41 released, the horizontal arm 37 of the bracket 35 is positioned so the projection 46 is in precise contact with the gage block. When this occurs, the nuts 41 may be turned up and the bracket 35 clamped in place. This produces the precise horizontal position of the axes of the roller modules in a common horizontal plane and the stock placed between and on the adjacent surfaces of the roller modules and secured thereto by the roller 97 is truly and precisely aligned.

As noted, the stock or work piece is now precisely positioned with its longitudinal axis absolutely horizontal and the projected end thereof is presented for reduction to form the desired punch. Reference is made to the previous comment that the grooves 66 for the O-rings are of a size and depth proportional to the section diameter of the related O-ring 67 so the surface of the O-ring extends above the diameter of the roller module 60 a controlled amount sufficient to aid in the function or driving the work piece through friction contact therewith. The work piece laying in the V between the roller modules is secured and held tight against the metal surfaces thereof by the roller 97 which is a pressure roller. The latter exerts sufficient force against the work piece under the controlled bias thereon through the medium of the lever 65 to cause this to lie tight against the metal surfaces of the roller modules, continuously displacing the rubber of the two O-rings 67, as they are rotatably driven under the influence of the gear belt 18 through the medium of their integrated gear pulleys 19 and 21. The work piece is rotated in the desired direction by its contact with both surfaces of the compressed O-rings 67 and with the metal circumference of the projections 61 and 62 in which the O-rings 67 nest. Whether a skew roller 97 is utilized as the pressure roller, a roller in a plane common to a transverse plane common to the roller modules or a device providing a pressure point contact is employed as a pressure medium, the roller modules with the pressure medium will always form a stable platform for the round body of the work piece as it is being rotated.

Attention is directed to the fact that in this specific embodiment of the invention shown in FIGS. 1 through 8, due to the significance thereof, the simple arrangement for a skew roller has been illustrated. As noted previously, dependent on which flat 94 is uppermost, the roller 97 will be angled in reference to the longitudinal axis of the work piece in one or the other of two directions which are oppositely inclined to the longitudinal axis of the work piece. Depending on the direction of the inclination, there will result on energizing the motor 13 and drive of the roller modules through the medium of the belt 18, simultaneously with rotation of the work piece, an induced movement of the work piece in the direction of its longitudinal axis either forwardly or rearwardly from an established position. In this way, it may be seen that a grinding or other cutting tool may be applied to one section of the work piece and move a portion of its length as determined by the travel permitted. The front and rear stops may be suitably utilized in an obvious manner to deter-

mine the degree of travel permitted for the work piece in the sense of its axial direction as mounted to the roller modules. If the work piece is to be moved from a position determined by a back stop outwardly a predetermined degree, then the front stop in the form of the bar 104 will be appropriately positioned from the adjacent end of the work piece in the first instance. The rear stop may be utilized in a similar manner.

The design and use of the skew roller as described is unique since under the influence of the bias which is applied thereto through the medium of the arm 65, the shaft mounting the roller may be moved laterally parallel to the longitudinal axis of the work piece, yet the roller will maintain the same angle or skew and still contact the body of the work piece at a constant radial location.

Attention is now directed to the operation and function of the eccentric mount provided for the roller module 60'. As will be readily apparent, during the operation of the work holder the location of the roller module may be simply adjusted to best suit the diameter of the work piece. Note that the adjustability of the module 60' to and from the module 60 is infinite. The roller module 60' may be placed in one extreme at a location nearly touching the roller module 60 at its outermost peripheral surface portions which include the O-rings 67. From this location, by a rotation of the cap 73 one can achieve an eccentric action producing infinite steps of adjustment of the roller module 60' away from the roller module 60 in a manner believed obvious. The degree of adjustment may be easily made to suit increasing diameters of the work piece. This eccentric control and adjustment provides a means of prolonging the potential operating life of the work holder. For example, when very small work pieces are clamped securely between the roller modules, a very large radial load may be generated on the driven rollers and their supporting bearings. As the small work piece closely approaches the common center line of the large roller modules, the radial load on these rollers increases exponentially, though the downward clamping force remains constant. Recognizing this fact, the feature of the eccentric adjustability of the roller module 60' provides means permitting a skilled operator to easily adjust the center distance of the roller modules and minimize the possibility of generating extreme radial load values.

The eccentric adjustability of roller module 60' also is important for reworking or reconditioning the working surfaces of the rollers. For example, by an eccentric adjustment of the roller module 60', one may move the outer periphery thereof into firm contact with the roller 60 and the mounted O-rings 67. In this position, the roller module 60' may be driven on energizing the motor 13 to rotate on its own axis and when brought into contact with the grinding wheel, its circumference may be re-ground very accurately. It is obvious, of course, that if any inaccuracy is produced by wear, it will tend to appear on the roller module 60'.

The eccentric mount of the roller module 60' is also important in that the adjustability as provided thereby eliminates the need for using rollers of a specific or constant diameter. When a new or re-worked roller is used, the eccentric adjustability allows a correct relationship to be easily achieved between the roller

modules, regardless of the diameter of the roller 60', within rather wide limits. As will be apparent, this feature increases greatly the potential useful life of the roller module of the invention.

To continue with the notation as to the importance of the various features of the invention structure previously described, attention is now directed to the clamping device embodied in conjunction with the lever 65, as represented with the associated control arm defined by the screw member 84, the biased spherically contoured washer 86, the spring 89, the screw cap 90 and the calibrated sleeve 88. In the instance of the illustration, the rear pivot for the arm 65 is placed at one remote end of the bracket arm 36 which commonly mounts the roller modules and their parallel shafts. Further, the arm 65 is pivoted on the side of the roller modules most adjacent the eccentrically adjustable module 60'. When, for example, a diameter of an applied work piece is increased over that previously worked and the roller module 60' is eccentrically adjusted to move further and further away from the roller module 60, the design is such that the third or clamping roller or clamping device mounted on the arm 65 will continue to exert a force on the work piece the direction of which tends to remain normal to the center line between the axes of the two roller modules. The invention, in respect to the clamp arm, does simply provide, also, a means for quick mount thereto of any selected device for applying the control pressure point on the top of the work piece biased to the roller modules. In this respect, attention is directed to the device shown in FIGS. 9 and 10 of the drawings.

Referring to FIGS. 9 and 10, one can use as a shaft inserted in the opening in the projected end of the arm 65, rather than the shaft 93, a shaft 113 which can have disposing within the passage 92 a shaft portion having diametrically opposed flats by means of which the shaft may be held in one of two reverse positions by a set screw such as in the case first described. The difference here is that the projected end of the shaft 113 in this case which extends perpendicular to and forwardly of the arm 65 does not have a working of its end. Rather the axis of the entire shaft and its diameter is uniform. The projected end of the shaft 113 is fixed in a vertically centered relation to a vertically oriented narrow plate 114 the respective ends of which are tapered. As shown in FIG. 9, at the apex of the upper taper is a rectangular slot receiving the base of a blade 115 presenting a narrow flat edge running from front to rear and in a line parallel to the axes of the roller modules. Centered between the fore and aft extremities of the projected tip of the blade 115 is a notch 116 which divides the blade edge into fore and aft longitudinally spaced rectangular bearing portions 117 and 118. Now looking to the lowermost extremity of the plate element 114, the dependent apex is rounded to circumscribe immediately within the same an aperture in which is fixed a pivot pin 119. It is noted that the dependent apex of the plate 114 is reduced in thickness in a manner to leave it centered between the front and rear faces of the plate 114. The pivot pin 119 has projections 120 of reduced diameter terminating in the respective front and rear planes of the plate 114. Each of the projections 120, as seen in FIG. 10, mount a roller bearing 121.

Thus, when the skew roller previously described is not needed, it may be replaced with the device afforded by the plate 114. As will be self-evident, where the hold down medium afforded on the arm 65 is the double roller bearings 121, the same will exert pressure at longitudinally spaced points on the work piece held down between the roller modules. If the work piece is of extremely small diameter, then the plate 114 may be reversed by release of the set screw on its shaft portion 113 to reverse the flats thereon and the set screw reapplied, whereupon thin longitudinally spaced edge portions of the blade 115 may be used to exert pressure on a very small diameter work piece and the same will be effectively held and balanced while work is done thereon.

The extreme simplicity and versatility of this optionally positioned hold down unit of FIGS. 9 and 10 should be readily obvious. In a very simple and effective manner there is achieved a highly utilitarian tool. Not only is the tool effective but very economical to fabricate.

Attention is now directed to FIG. 7 of the drawings to illustrate yet other features of the invention. The deep central channel or circumferential groove 63 in the roller modules can in the use of the invention work holder serve specific and useful functions. These grooves can, in mounting work pieces such as short punches or short insert dies having expanded heads, serve to accommodate the expanded head in the side-by-side grooves 63 of the roller modules such as shown in FIG. 7. FIG. 7 shows also the orientation of the parts of the bracket controls where a tilting of the work piece is desired. Particular attention should be had in respect to the spherical seating washers adjusting to accommodate the tilt of the bracket 35. There is also shown the useful function of the utilitarian front and back stops that are so simply incorporated in the invention structure.

It must be emphasized that the degree of flexibility and utility of the various components of the invention work holder makes them work in unison to achieve a degree of efficiency and accuracy not heretofore found in prior art work holders. Moreover, one finds that even the very elements of the work holder per se have general utility and they serve with considerable benefit in other equipment and for other purposes. For example the unique roller module concept of the invention provides a roller device which may be stocked as a unit and incorporates a drive medium which can be used or not used, as needs require. The roller module can, of course, be made and stocked with an eccentric or concentric shaft portion for mount thereof as needs require. The construction which enables the embodiment therein of O-rings to achieve a most effective engagement and drive is yet another advantage of the roller module per se.

Further, the drive system as afforded by the present invention is unique. Here we have a continuous arrangement of a gear belt which provides a simultaneous and conjoint drive of the rotating elements, which drive is uniformly effective, irrespective of the spacing between the roller modules in the system as provided. A key feature is the unique placement and relationship of the two idler pulleys, one of which is small and smooth and the other which is channelled and func-

tions dually to control the belt moving over the smooth roller. By virtue of the arrangement, the drive belt is so maintained that there may be substantially uniform tension throughout.

Above all the preceding, the sum and substance of the invention is that the components of the embodiments may be made inexpensively yet serve to achieve a most precise frame of reference for a round work piece so that any work done thereon is true and precise in character. In use of the unique roller modules, the rubber O-rings function to smooth out and compensate also for inaccuracies which might otherwise be produced in working by the existence of grinding dust between the rollers and the rollers and the work piece. If desired one may apply O-rings in the groove 66 of the eccentrically mounted roller modules 60'. But this is not as desirable where smaller diameter work pieces are to be held and rotated.

The foregoing is but an illustrative description of an invention embodiment and some of the merits thereof. Other advantages and variations in construction will be readily apparent to those versed in the art and such is comprehended within the scope of the present invention.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes or putting the invention into effect and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described our invention, we claim:

1. A work holder including means defining a base, a bracket pivotally mounted on said base, means defining a pair of adjacent rollers mounting to said bracket, said rollers having their axes disposed in parallel spaced relation and being mounted to receive a tubular or cylindrically formed work piece or operating element in bearing relation to upper adjacent surface portions thereof, means for effecting a selective containment of said work piece to said rollers and one of said rollers having in connection therewith means for resiliently accommodating the mount of a work piece which means is operable to function as a frictional drive means for said work piece as mounted to said rollers, said rollers being comprised in respective roller means, one of said roller means having in connection therewith a shaft which is in fixed relation to said bracket, the other of said roller means having in connected relation thereto an eccentrically disposed shaft mounting in bearing relation to said bracket and there being means for rotating said eccentrically disposed shaft to establish infinitely variable degrees of spacing between the adjacent upper surface portions of said roller means to accommodate work pieces or operating elements of varying circumferential extent.

2. Apparatus as set forth in claim 1 characterized by a lever pivotally mounted on said bracket having, at a portion thereof displaced from its pivot, means for holding a work piece or operating element to said roller means, means to normally bias said lever from a holding position and means selectively disposable to clamp the holding means and the lever which mounts the same in a selectively biased relation to the work piece.

3. Apparatus as set forth in claim 2 characterized by cam means on said lever means and said clamp means being pivotally mounted to said bracket and operative on said cam means to control the position of said lever.

4. Apparatus as set forth in claim 3 characterized by said cam means having a portion thereof defining a locking recess for said clamp means, the disposition of said clamp means therein establishing a firmly contained position of the work piece or operating element to said roller means.

5. Apparatus as set forth in claim 4 characterized by said cam means having upward and downward sloping surfaces as referenced to said lever, said clamp means including a cam follower means having an arcuately contoured surface following said cam means and said locking recess being arcuately contoured to provide for the seating therein of said follower means to provide a locked position of said lever and said holding means.

6. Apparatus as set forth in claim 5 characterized by said clamp means including a screw device mounting a cap-like nut, and spring means interposed between said follower means and said cap-like nut to provide for a selective bias of said follower means to said lever.

7. A work holder including means defining a base, a bracket pivotally mounted on said base, means defining a pair of adjacent rollers mounting to said bracket, said rollers having their axes disposed in parallel spaced relation and being mounted to receive a tubular or cylindrically formed work piece or operating element in bearing relation to upper adjacent surface portions thereof, means for effecting a selective containment of said work piece to said rollers and one of said rollers having in connection therewith means for resiliently accommodating the mount of a work piece which means is operable to function as a frictional drive means for said work piece as mounted to said rollers, said base including thereon pivot rod means and means containing said pivot rod means for rotation on to said base, said pivot rod means being connected to form the base of said bracket to provide for tilting of said bracket as and when needs require to establish a predetermined orientation of the work piece or operating element.

8. Apparatus as set forth in claim 7 characterized by said bracket having a right angle configuration including a generally horizontally disposing arm and a generally vertically projecting arm, the said vertically projecting arm mounting thereon said rollers and there being means on said base and said horizontally projected arm to provide for a controlled tilt of said bracket and the axes of said.

9. Apparatus as in claim 7 characterized by further means connecting said bracket to said base including a shaft-like device projecting through a portion of said bracket with clearance therebetween, means on said shaft-like device accommodating adjustment of said bracket in a tilting motion on said base and for locking said bracket in a selected attitude referenced to said base.

10. Apparatus as in claim 9 characterized by said shaft-like device being threaded, at least in part, the threaded part passing through said bracket and means having mating arcuately contoured surface portions disposing on said threaded part adjacent said bracket for accommodating said bracket tilting motions.

11. A work holder including means defining a base, a bracket pivotally mounted on said base, means defining a pair of adjacent rollers mounting to said bracket, said rollers having their axes disposed in parallel spaced relation and being mounted to receive a tubular or cylindrically formed work piece or operating element in bearing relation to upper adjacent surface portions thereof, means for effecting a selective containment of said work piece to said rollers and one of said rollers having in connection therewith means for resiliently accommodating the mount of a work piece which means is operable to function as a frictional drive means for said work piece as mounted to said rollers, said means for selective containment of a work piece or operating element being hold down means constructed to have reverse positions of application, said hold down means including roller means having a shaft means mounting the same to said bracket, said roller means being mounted at an angle to the axis of said shaft means, and said shaft means having means defining selective positions of application thereof to said bracket to change the attitude of the connected roller means in its application as hold down means.

12. A work holder including means defining a base, a bracket pivotally mounted on said base, means defining a pair of adjacent rollers mounting to said bracket, said rollers having their axes disposed in parallel spaced relation and being mounted to receive a tubular or cylindrically formed work piece or operating element in bearing relation to upper adjacent surface portions thereof, means for effecting a selective containment of said work piece to said rollers and one of said rollers having in connection therewith means for resiliently accommodating the mount of a work piece which means is operable to function as a frictional drive means for said work piece as mounted to said rollers, said rollers including on the periphery thereof spaced circumferential projections adjacent of which define therebetween a channel, each of said circumferential projections on at least one roller further including a circumferential recess.

13. Apparatus as in claim 12 including in each circumferential recess a resilient material a limited portion of which projects from the surface of the roller.

14. A work holder including means defining a base, a bracket pivotally mounted on said base including a vertically projected portion and a horizontally projected portion, said vertically projected portion mounting thereon a pair of adjacent rollers the axes of which are disposed in adjacent parallel spaced relation, said rollers mounting to receive a tubular or cylindrically formed work piece or operating element in bearing relation to upper adjacent surface portions, said bracket mounting thereon a lever including hold down means and means for operating said lever to produce a triangular position of said hold down means as referenced to said rollers whereby to effect a controlled containment of the work piece to said rollers, said base having in connected relation thereto a shaft-like

member having threaded portions, said horizontal portion of said bracket having an aperture to accommodate said shaft-like member to project therethrough with substantial clearance therebetween, nut elements on said threaded portions to opposite sides of said horizontal portion of the bracket and means interposed between said horizontal portion of said bracket, to either side thereof, and said nuts to accommodate relative tilting movement of said horizontal portion of said bracket and provide a base for a firm clamping thereof to said horizontal bracket portion by said nuts.

15. Apparatus as set forth in claim 14 characterized by there being additional related means on said base and said horizontal portion of said bracket to dictate a precision position of said bracket and said roller means in reference to said base.

16. Apparatus as set forth in claim 15 characterized by said bracket including a projected arm portion mounting pivot means for said lever mounting said hold down means, said bracket further mounting thereon a pivot and in connection therewith a vertically projected clamping means for said lever, and said lever and said clamping means having interrelating parts in continuous bearing engagement, the adjustment of said clamping means positioning said interengaging parts to achieve a predetermined bias of said hold down means to the work piece or operating element bearing on said rollers.

17. A work holder, including support means, means defining a pair of adjacent rollers mounting to said support means, said rollers having their axes disposed in parallel spaced relation and being mounted to receive a tubular or cylindrically formed work piece or operating element in bearing relation to upper adjacent surface

portions thereof, individual shafts mounting said rollers in said support means, at least one of said shafts being eccentrically adjustable to effect relatively eccentric adjustment of said rollers, and means for effecting a selective containment of a work piece or operating element in bearing relation to surface portions of said rollers, said last named means including an anti-friction part adapted for individual skew adjustment.

18. A work holder, including support means, means defining a pair of adjacent roller modules mounting to said support means, said roller modules having their axes disposed in parallel spaced relation and being mounted to receive a tubular or cylindrically formed work piece or operating element in bearing relation to adjacent surface portions thereof, the surface portions of said modules being identically formed with one thereof providing longitudinally spaced apart circumferential lands making a direct relatively unyielding contact with the work piece and the surface portion of the other module having resilient ring means recessed in groove means between said circumferential lands for relatively yielding frictional contact with the work piece, said groove means being of a size and depth proportional to the cross sectional configuration of the resilient means so that said resilient means tends normally to extend above the surface portion of said other roller by a controlled amount, said groove means being constructed to provide for radial displacement of said resilient means therein in response to rotation of said roller modules in the presence of an applied selective containment of the work piece to said modules, and means for effecting a selective containment of said work piece to the surface portions of said roller modules.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,695,468 Dated October 3, 1972

Inventor(s) Harry G. Stevens; Robert Earl Smith

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the "ABSTRACT", line 3, "baring" is corrected to read
-- bearing --.

Column 10, line 3, -- of -- should be inserted after "block".

Column 15, Claim 8, last line, add -- rollers -- before the
period.

Signed and sealed this 8th day of May 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents