March 11, 1958 R. O. SHURSON 2,826,009

WORK HOLDER FOR LAPPING MACHINES

Filed Dec. 10, 1954 3 Sheets-Sheet 1

FIG. 1

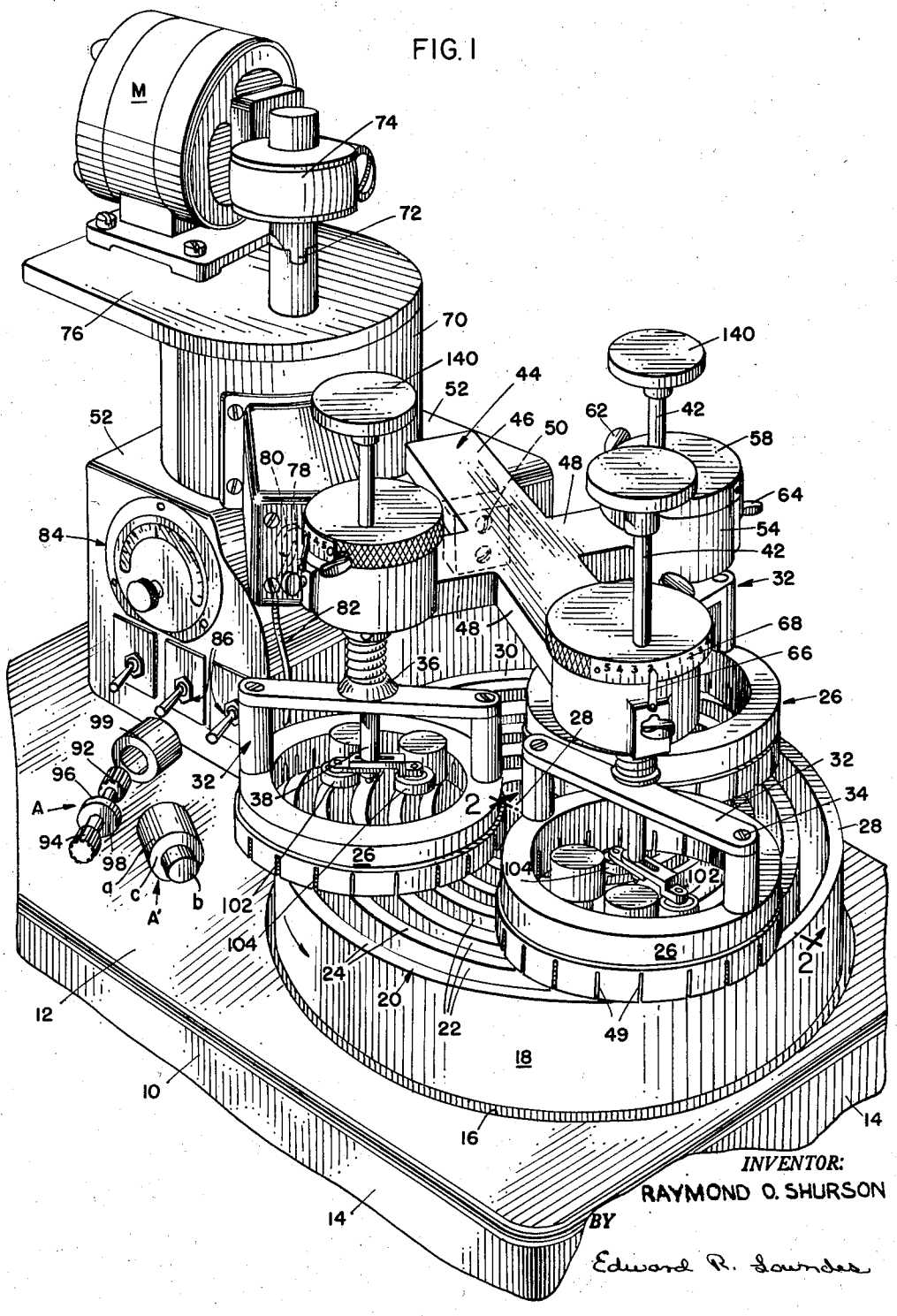

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FIG. 2

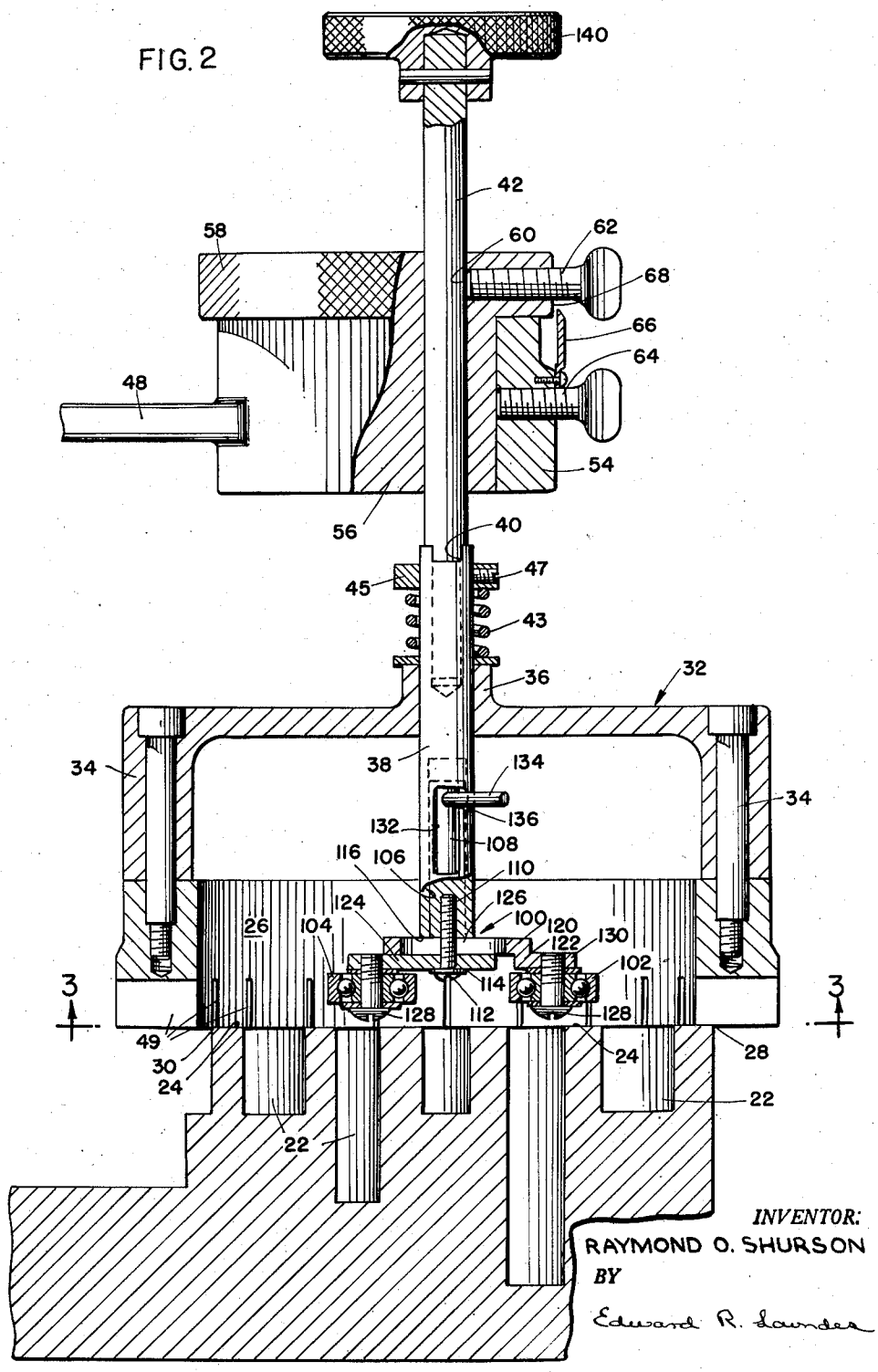

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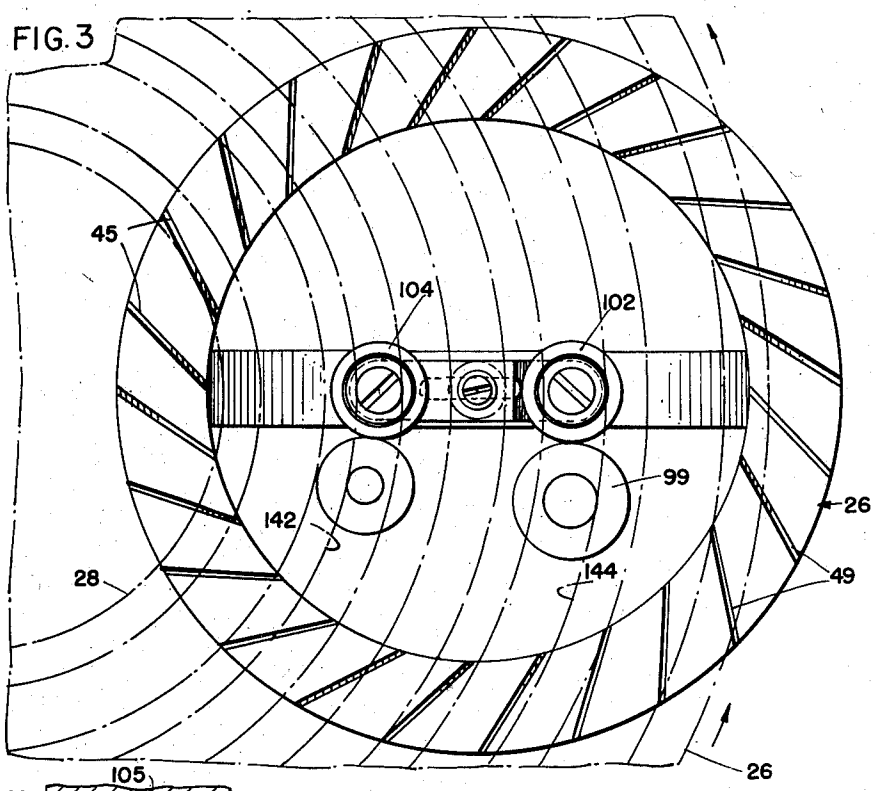
FIG. 3



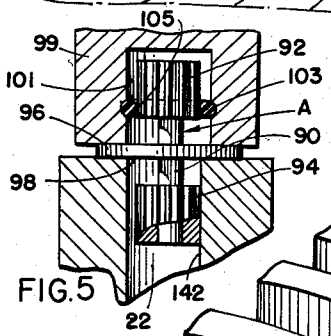


FIG. 5

FIG. 4

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WORK HOLDER FOR LAPPING MACHINES

Raymond O. Shurson, Chicago, Ill., assignor to Crane Packing Company, Chicago, Ill., a corporation of Illinois

Application December 10, 1954, Serial No. 474,546

7 Claims. (Cl. 51—129)

The improved work holder comprising the present invention has been designed primarily for use in connection with the positioning of articles on a lap plate, the plate being formed with one or more annular grooves in the upper surface thereof and the articles being formed with shoulders thereon which are designed to bear downwardly on the land surfaces of the lap plate which exist on opposite sides of the various grooves. Certain articles, as for example valve disks or plates, rotary seal seats, fuel pump parts and a wide variety of other objects, are formed with an annular surface thereon which is axially spaced from the opposite ends of the part thus defining a shoulder, the surface of which it is desired shall be lapped to a substantially flat condition.

As shown in the United States patent to Roshong, No. 2,597,382, dated May 20, 1952, for Apparatus for Lapping Shoulders, it has been customary to maintain such articles on the grooved lap surface with the shoulders undergoing lapping resting on the land areas on opposite sides of the intervening groove by means of a centering spindle which projects into an opening provided in the article and which serves to hold the article on the lap to prevent the same from riding with or revolving about the lap axis. Where the character of the work is such that it is relatively heavy or where it possesses considerable height, it has been found that the restraining force acting on the article at a considerable distance from its region of support on the lap surface causes a tilting of the article and this tilting may result either in a gouging of the lap surface or in the application of unequal pressure between the lap surface and the various increments of the surface resting thereon and undergoing lapping. Furthermore, where the diameter of the annular surface on the article undergoing lapping is relatively small and the width of the groove existing between the adjacent land areas on the lap is, as a consequence, relatively narrow, the friction differential between the lap and surface on opposite sides of the groove cannot be relied upon to induce free rotation of the article supported on the lap inasmuch as the circumferential speed of the outermost land area is not appreciably greater than the circumferential speed of the innermost land area and for this reason a more positive method of causing rotation of the article on the lap surface is required.

The present invention is designed to overcome the above noted limitations that are attendant upon the use of apparatus such as has been shown in the patent to Roshong as well as to provide a more positive means for effecting induced rotation of an article resting on the lap surface. Toward this end the invention contemplates the provision of a work holding means which will effectively maintain an article of the character set forth above on a grooved lap surface with its annular shouider resting upon the land areas of the lap while at the same time holding the article against revolution about the axis of the lap while permitting a more effective frictional contact between the article and a surface of the lap plate

which is sufficient to provide the necessary induced rotation for causing the article to rotate about its own axis.

The provision of an apparatus of the character briefly outlined above being among the principal objects of the present invention, it is a further object of the invention to provide a work holder of this character which will accommodate the positioning of multiple objects on a multi-grooved lap plate, a single work holder serving to maintain two or more of the objects in their respective radially displaced positions.

It is a still further object of the invention to provide a work holder of this sort which is readily adjustable to accommodate objects of different diameter as well as to accommodate varying spacing between the land areas on the lap plate which may be encountered. A similar and related object of the invention is to provide an adjustable work holder of this sort wherein adjustments may be made from time to time wherever necessary without stopping the operation of the machine and without the necessity of unfastening or disassembling any of the machine parts.

Yet another object of the invention is to provide a work holder designed for use in connection with grooved lap plates, particularly lap plates having multiple grooves therein which will permit the insertion of work into the machine and the removal of work therefrom without stopping the operation of the machine.

Still another object of the invention is to provide a work holder for lapping machines of this character which will not interfere with the operation of the usual conditioning or wear rings employed for maintaining the lap plate flat as to contour and which will permit the work to be lapped within the conditioning ring thus economizing in available lapping area and contributing toward maximum machine output over any given period of time.

The provision of a work holder for lapping machines of the type set forth above which is extremely simple in its construction and which therefore may be manufactured at a low cost; one which is comprised of a minimum number of moving parts and which therefore is unlikely to get out of order; one which, when installed in the lapping machine, is readily accessible at all times, even during machine operations, for purposes of inspection or adjustment; one which is capable of substitution when necessary without shutting down machine operation; and one which is otherwise well adapted to perform the services required of it, are further desirable features that have been borne in mind in the production and development of the present invention.

Other objects and advantages of the invention, not at this time enumerated, will become more readily apparent as the nature of the invention is better understood.

In the accompanying three sheets of drawings forming a part of this specification, a preferred embodiment of the invention has been illustrated.

In these drawings:

Fig. 1 is a fragmentary perspective view of a lapping machine having a multi-grooved lap plate and showing the improved work holder comprising the present invention operatively associated therewith. In this view a pair of articles of the type capable of being lapped by the present machine is shown resting upon the machine table surface.

Fig. 2 is a sectional view taken substantially along the plane indicated by the line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 2 in the direction indicated by the arrows.

Fig. 4 is an enlarged detail fragmentary perspective view, partly in section, taken in the vicinity of the lap surface and illustrating the manner in which the present

work holder operates to maintain the work operatively positioned on the lap surface, and

Fig. 5 is a sectional view taken substantially along the plane indicated by the line 5—5 of Fig. 4.

Referring now to the drawings in detail and in particular to Fig. 1, there is shown a lapping machine of the general type shown and described in the United States reissue patent to Bullard, Re. 23,937, dated February 8, 1955, for Lapping Machine.

Briefly, this machine involves in its general organization a stationary framework **10** of table-like design and including a table top **12** having apron-like sides **14**. Projecting upwardly through a circular opening **16** in the table portion **12** is a rotatable lap plate **18** preferably formed of cast iron or other suitable material and having an annular abrading surface **20** provided with a series of radially spaced circumferentially extending grooves **22** formed therein which divide the surface **20** into a series of relatively narrow annular land areas **24**. The upper lapping surface **20** of the lap plate **18** is adapted to receive thereon a plurality of wear rings **26**, commonly known as conditioning rings. These rings are preferably formed of the same material as the material of the lap plate, i. e. cast iron, and the rings are of such diameter that they may be positioned on the lap area so as to overlap slightly both the inner and outer peripheries **28** and **30** respectively as clearly shown in Figs. 2 and 3. The conditioning rings **26** are adapted to rest frictionally on the surface of the lap annulus, bridging the various grooves **22** and land areas **24** and means are provided for preventing them from riding with the lap, so to speak, or in other words, for holding them against revolution about the axis of the lap so that each ring is held permanently within its own sector of the lap annulus. In order to thus support the rings against revolution about the lap axis, each ring has secured thereto an inverted U-shaped yoke **32** which may be secured to the upper rim of the wear ring by anchoring studs **34** and which assumes a diametric position with respect to the wear ring. Each yoke is formed with a central hub portion **36** which loosely surrounds a vertically extending spindle **38** which interlocks by a pilot connection at its upper end as at **40** with a radially adjustable spindle **42** which also is capable of angular adjustment and which is suitably carried in the machine framework in a manner that will be made clear presently. The degree of pressure exerted by each conditioning ring on the lap annulus may be regulated by adjusting the compressional force exerted by a coil spring **43** on the yoke **32** by means of a vertically adjustable collar **45** which surrounds the spindle **38** and having a set screw **47** associated therewith. A small or limited amount of universal movement is permitted between each conditioning ring **26** and the vertical axis of its respective spindle **38** so that the ring will at all times rest squarely upon the lap annulus in face-to-face contact with the land areas **24** thereof. A series of spaced angularly disposed slots **49** are formed in the lower regions of each ring **26** and are effective to more efficiently distribute the lapping compound which is supplied to the lap surface as will be described subsequently.

Spaced above the general plane of the lap annulus and overlying the latter is a horizontally disposed spider **44** (Fig. 1) including a shank portion **46** and three spider arms **48**. The spider **44** is supported above the lap plate by means of a depending attachment flange shown in dotted lines in Fig. 1 at **50** and which may be selectively secured in various positions of vertical adjustment to a housing **52** mounted on the table portion **12** and which serves to support certain electric control instrumentalities associated with the machine. The free end of each spider arm **48** is formed with an enlarged boss **54** (see also Fig. 2) in which there is rotatably disposed a cylindrical adjusting block **56** having a knurled head portion **58**. The adjusting block is formed with an eccentrically displaced vertical bore **60** therethrough in which the vertically disposed spindle **42** is adapted to be clamped in any desired position of adjustment by means of a set screw **62**. The adjusting block **56** is capable of being clamped in any selected angular position of adjustment by means of a clamping screw **64**. An indicator or pointer **66** cooperates with a suitable scale **68** provided on the head portion **58** so that the angular position of the adjusting member **56** and the consequent extent of radial displacement of the spindle **42** with respect to the central axis of the lap surface may be readily ascertained.

The mechanism just described for shifting the radial position of the conditioning rings **26** allows the lap surface to be automatically dressed during lapping operations under controlled conditions whereby the lap annulus may be brought to a flat condition when the same is found to have assumed either a convex or a concave shape. The extent of overhang of the wear rings on either the outside or inside edges **28**, **30** is the control factor for effecting dressing operations. If the overhang is greater at the outside than at the inside, the unbalanced force will tend to wear the lap surface convex. Conversely, if the amount of overhang at the inside is greater, the lap will tend to become concave. In the former instance, it will be necessary to adjust the member **56** so that the spindle **42** will be moved radially inwardly and in the latter instance it is necessary to make the adjustment so that the spindle will be moved radially outwardly a predetermined distance.

It is essential to the operation of a machine of this character that the surface of the lap plate be supplied with a lapping compound consisting of a gritty fluid including a suitable vehicle in which particles of grit or abrasive are maintained in suspension. Accordingly, a tank or receptacle **70** (Fig. 1) is supported above the table portion on the housing **52** and has disposed therein an agitator mechanism (not shown), the central shaft or spindle **72** of which projects upwardly above the tank and is driven through a suitable gear reduction mechanism **74** from an electric motor M suitably supported on a platform **76** mounted on the tank **70**. The liquid contained within the tank **70** and in which the particles of grit are suspended, is adapted to flow outwardly through a discharge orifice **78**, the opening and closing movements of which are conducted by means of a solenoid actuated valve **80**. From the orifice this grit laden fluid may flow along a flexible wire **82** and be applied to the side of one of the conditioning rings **26** against which it bears so that fluid will be conducted to the ring and then distributed over the surface of the lap annulus **20** including the land areas **24** as the latter pass beneath the wear ring **26**. The housing **52** serves to support the agitator tank **70** as well as the various electrical control components of the machine. The lap plate **18** is adapted to be driven from an electric motor (not shown) suitably supported beneath the table top **12** and this motor together with the motor M as well as the solenoid valve **80** and certain timing mechanism designated generally at **84** all operate under the control of a series of switches **86** mounted on the side of the housing **52**.

The arrangement of parts thus far described is more or less conventional and no claim is made herein to any novelty associated with the same, the novelty of the present invention residing rather in the construction, combination, and arrangement of parts about to be described.

Referring now to Fig. 1, two articles, one designated at A and the other designated at A', are shown resting on the surface of the table portion **12**. The article A, illustrated herein purely for exemplary purposes, is in the form of valve parts designed for use in connection with air craft fuel pumps. Each part A includes a central stem or shaft **90** carrying at its opposite ends a pair of gears **92** and **94** respectively. At a point intermediate the two gears

is a disk element **96** having an annular surface **98** thereon which it is desired shall be lapped to a substantially flat condition. The article A' is in the form of a cylindrical object having a body portion *a* and a stem portion *b*.

According to the present invention it is contemplated that more than one part will be lapped simultaneously by the machine and that the various parts undergoing lapping may be identical or of different design. Accordingly, for illustrative purposes, each conditioning ring is shown as enclosing one of the parts A and one of the parts A'. Each part A has its lower stem portion **90** and gear **94** disposed within one of the grooves **22** and with the surface **98** on the disk **96** loosely resting on a pair of adjacent land areas **24**. In the present instance, as shown in Fig. 4, the two parts A and A' overlie the grooves **22** which are not adjacent each other but which are disposed on the opposite sides of an intermediate groove. In this manner the disk **96** of the part A has its surface **98** resting on two different land areas **24** from the land areas on which the body portion *a* of the article A' rests and there is no chance for interference between the movements of the two parts A and A'. In order to increase the effective lapping pressure between the surfaces **98** of the articles A and the lap surfaces **24**, a cylindrical weight **99** is positioned over the upper gear **92** and this weight exerts a downward gravitational influence on the article. The weight **99** is formed with a socket **101** therein, the wall of which is formed with an annular semi-circular groove **103** in which there is disposed a resilient O ring **105**, the O ring serving to frictionally grip the teeth on the gear **92** and maintain the weight **99** centered over the article.

In order to restrain the articles A and A' against revolution about the axis of the lap the improved work holder of the present invention has been provided and is designated in its entirety at **100**. The work holder includes a portion of the adjustable mechanism shown in the upper portion of Fig. 2 as well as the spindles **38** and **42** and the additional mechanism carried at the lower end of the spindle **38**. This latter mechanism, briefly, includes a pair of antifriction members or rollers **102** and **104** respectively capable of individual adjustment with respect to the spindle **38** and each of which is adapted to be suspended from the spindle **38** at a predetermined position positioned directly in the path of movement of one of the articles A or A' resting frictionally on the lap so that the roller will bear against the cylindrical side of the weight **99** carried by the article and so that the article will be restrained in its tendency to ride with the lap. In order to thus support the rollers **102** and **104**, the lower end of the spindle **38** is provided with a relatively deep socket **106** in which there is slidably and turnably mounted an elongated clamping rod **108** capable of being moved from the retracted position shown in Fig. 2 in full lines to the extended dotted line position. The lower end of the rod **108** threadedly receives a clamping screw **110** having an enlarged head **112** and a washer **114** thereon. Interposed between the washer **114** and the underneath clamping surface **116** of the clamping rod **108** are the horizontal arm portions **120** of a pair of adjustable roller supports **122** and **124** respectively carrying the rollers **102** and **104**. The arm portions **120** of the two supports are provided with elongated narrow slots **126** through which the clamping stud **110** passes. The supports **122** and **124** are similar in their construction and each carries at its free outer end a fastening screw **128** on which screw the respective rollers **102** and **104** are rotatably mounted. The clamping member **122** is provided with a laterally offset portion **130** so that the two studs **128** and their respective rollers may be positioned at substantially the same elevation with respect to the lapping surface of the lap plate **18**.

The side wall of the socket **106** is provided with an elongated vertical slot **132** therein and an operating handle or pin **134** projects through the slot **132** and into the rod **108** and is capable of being latched against a shoulder **136** on the side wall of the slot **132** so as to hold the rod **108** in its elevated retracted position wherein the lower end of the rod is drawn within the confines of the socket **106** and the two arms **120** of the clamping members **122** and **124** are firmly clamped against each other with the upper surface of the overlying arm being clamped against the lower end of the spindle **38**. With the parts in this position, the two arms **122** and **124** are securely held against radial or angular shifting movement and the rollers **102** and **104** respectively carried thereby are anchored in relative fixed positions. When it is desired to adjust the position of one or both of the two rollers, it is merely necessary to move the handle **134** from its latched position on the shoulder **136** so that the clamping rod **108** may be moved downwardly in the socket **106** to release the arms **120**, after which the positions of the rollers **102** and **104** may be manually adjusted and thereafter the clamping mechanism again tightened in the manner previously described so that these rollers will remain locked in their adjusted positions. If desired, one or both of the opposed overlying surfaces on the arms **120** may be knurled or otherwise roughened to afford good frictional characteristics between these two parts and prevent slippage of one upon the other.

Referring now to Fig. 2, it will be seen that the upper end of each of the spindles **42** carries a knurled adjusting knob **140** by means of which the angular position of the rod **42** and consequently of the rod **38** and roller supporting arms **122** and **124** respectively may be adjusted to vary the effective radial distance between the two rollers **102** and **104**. In certain instances, it may be found desirable to utilize adjacent grooves **22** in the lap plate so that two articles undergoing lapping will share one of the common land surfaces **24** with one article being positioned circumferentially in advance of the other article. This has the effect of reducing the effective radial extent between the two articles and to accommodate such an arrangement the spindle **42** may be adjusted so that the two arms **122** and **124** maintain their respective rollers in positions which have an appreciable circumferential increment of displacement as well as the necessary radial increment of displacement. As a matter of fact, a wide diversity in the relative displacement as well as in the actual longitudinal and circumferential displacement of the rollers relative to the lap axis may be effected with the possible range of adjustment of the two arms **122** and **124**.

In the application of the work pieces or articles to the lap, the adjusting mechanism just described will be locked in an adjusted position whereby one of the rollers **102** or **104** as the case may be is positioned in the normal path of movement of an article disposed in one of the grooves **22**. The roller will be positioned slightly inwardly or outwardly from the circular centerline of the article with respect to the lap axis so that the article will have an unstable degree of equilibrium with respect to the roller or in other words so that the article will be unbalanced on the roller and tend to ride on the lap in such a manner as to pass around the roller either by being thrown radially inwardly or radially outwardly on the lap surface. If the tendency is for the article to move radially inwardly, it will be prevented from doing so by virtue of the fact that the depending portion of the article, in the present instance the lower gear **94** thereof, will be forced against the inner vertical cylindrical wall **142** of the groove **22**. The article will then become lodged in a fixed position so that the resultant vectorial force exerted upon the article due to its frictional contact with the two land areas **24** on opposite sides of the groove, is directed between the roller and the restraining wall **142** and the article is thus prevented from continuing in a circular path around the axis of the lap. With the article thus restrained, the frictional contact of the depending gear **94** with the wall **142** will impart a counter clockwise rolling movement of the article A about a fixed vertical central axis so that all increments of surface area on

the surface 98 undergoing lapping, will be repeatedly moved into contact with the two land areas 24.

In Figs. 4 and 5 the roller 102 is shown as being positioned in the manner just described so as to cause the wall 142 of the groove to exert a frictional force against the article tending to rotate the same in a counter clockwise direction. The roller 104, however, is positioned slightly inwardly of the circular circumferential axis of the other article undergoing lapping and in such an instance there will be a tendency for the article to shift radially outwardly on the lap so that the gear 94 thereof engages the outer wall 144 of the groove 22. With the roller 104 thus positioned, an induced rotation will be set up in the article which is in a clockwise direction as viewed in Fig. 4.

Whether the rollers 102 and 104 be positioned so that the article is caused to bear against one side of the groove 22 or against the other side of the groove is merely a matter of choice and the extent or nature of the lapping operation will, in either instance, remain substantially the same. Theoretically, it would appear that where the article bears against the wall 144 and is thus caused to rotate in a counter clockwise direction as viewed in Fig. 4, a slightly faster abrading action would be attained because of the fact that increments of the surface 98 on the disk 96 undergoing lapping will have a higher speed of relative motion with respect to the outermost of the two land areas than when the article is being rotated in the opposite direction. However, since these surface increments reverse their direction of movement relative to the moving surface of the lap once during each rotation of the article, and since the difference in peripheral speed between increments of surface or on adjacent land areas 22 is very small indeed, the net overall effect afforded by positioning the roller in one or the other of the two described operative positions will be negligible. Moreover, since the weight of the condition-ring 26 far exceeds the weight of the articles undergoing lapping, the effect of any wear that may take place on the lap plate by virtue of its frictional contact with the articles will be effaced by the abrading action of the conditioning ring.

In Fig. 1, one of the three conditioning rings 26 is shown as receiving therein for lapping purposes a pair of articles A' including its cylindrical body portion *a* and its projecting stem portion *b*, the body portion providing an annular shoulder *c* which it is desired shall be lapped to a flat condition. The article A' possesses sufficient weight that the necessary degree of lapping pressure will be attained against the land surfaces 24 and since the body *a* is cylindrical, there is no necessity for employing weights such as are shown at 99 in connection with the gear parts. The articles A' are placed on the lap surface with the stems *b* thereof projecting into the grooves 22 so that they may bear against either the inner or outer side walls of the grooves to impart rotational movement to the articles about their vertical axes. The other visible conditioning ring is shown as receiving therein one of the articles A and one of the articles A' as previously described.

The invention is not to be limited to the exact arrangement of parts shown in the acompanying drawings or described in this specification since various changes in the details of construction may be resorted to without departing from the spirit of the invention. For example, the weights 99 employed in connection with the lapping of the annular surfaces on the various articles A are employed herein first because the nature of the article is such that its inherent mass is insufficient to give the necessary lapping pressure on the land areas 24. Secondly, the weights afford a true cylindrical surface against which the restraining rollers 102 and 104 may bear so that the articles may turn freely on the surface of the lap. Obviously, where articles which in themselves are possessed of sufficient weight to give the necessary lapping pressure and where these articles themselves have cylindrical surfaces positioned above the plane of the annular surfaces undergoing lapping, the use of the weights 99 may be dispensed with. Where the weights 99 are employed, they may be regarded as constituting a portion of the article undergoing lapping and in the following claims where the article is recited as bearing against the rollers 102 or 104, as the case may be, it will be understood that the article includes not only the illustrated gear parts but also the weight which is temporarily associated therewith for lapping purposes.

What I claim is:

1. In an apparatus for lapping an annular surface provided on a shoulder formed on an article concentric with a stem portion projecting beyond the shoulder, said article being formed with an exterior cylindrical surface above said shoulder, in combination, a machine framework, a rotatable lap plate mounted on said framework and having an annular groove providing land portions on opposite sides thereof, said lap plate being adapted to receive the article thereon with said annular surface resting on said land portions and bridging the distance beyond the same and with said stem portion extending into the groove, and means for restraining said article against revolution about the axis of rotation of the lap plate while permitting independent rotation of the article about its own axis, said means comprising an antifriction roller supported from the machine framework above the plane of the surface of the lap plate and positioned in the normal path of movement of the article, said antifriction roller having running engagement with said cylindrical surface on the article and being so positioned as to bear against the cylindrical surface of the latter so as to hold the same against circumferential movement on the lap plate and bias the article so that the stem portion thereof will bear against one side of the groove in rolling engagement with the latter to induce rotation of the article on the lap plate about its own vertical axis, said antifriction roller constituting the sole means for restraining said article against revolution about the axis of rotation of the lap plate.

2. In an apparatus for lapping an annular surface provided on a soulder formed on an article concentric with a stem portion projecting beyond the shoulder, said article being formed with an exterior cylindrical surface above said shoulder, in combination, a machine framework, a rotatable lap plate mounted on said framework and having an annular groove providing land portions on opposite sides thereof, said lap plate being adapted to receive the article thereon with said annular surface resting on said land portions and bridging the distance beyond the same and with said stem portion extending into the groove, means for restraining said article against revolution about the axis of rotation of the lap plate while permitting independent rotation of the article about its own axis, said means comprising an antifriction roller supported from the machine framework above the plane of the surface of the lap plate and positioned in the normal path of movement of the article, said antifriction roller having running engagement with said cylindrical surface on the article and being so positioned as to bear against said cylindrical surface of the article so as to hold the same against circumferential movement on the lap plate and bias the article so that said stem portion of the latter will bear against one side of the groove in rolling engagement with the latter to induce rotation of the article on the lap plate about its own vertical axis, and means for adjusting the position of said antifriction device radially of the lap plate, said antifriction roller constituting the sole means for restraining said article against revolution about the axis of rotation of the lap plate.

3. In an apparatus for simultaneously lapping annular surfaces provided on shoulders formed on a pair of articles having stem portions concentric with the shoulders and projecting therebeyond and having exterior cylindrical surfaces above the shoulders, in combination, a machine framework, a rotatable lap plate mounted on said frame-

work and having a pair of concentric spaced annular grooves formed therein, each providing land portions on opposite sides thereof, said lap plate being adapted to receive the articles thereon with the annular surface of the articles each resting on adjacent land portions and with the stem portion extending into the groove between said land portions, and means for restraining said articles against revolution about the axis of rotation of the lap plate while permitting independent rotation of the articles about their own axes, said means comprising a support carried by the machine framework, a pair of arms mounted on said support, a roller mounted on each arm and positioned above the plane of the surface of the lap plate in the normal path of movement of one of the articles, said rollers each having running engagement with the cylindrical surface on one of the articles and being so positioned as to bear against the cylindrical surface of the article so as to hold the same against circumferential movement on the lap plate and bias the article so that the stem portion of the article will bear against one side of the groove in which it is mounted in rolling engagement with said side of the groove to induce rotation of the article on the lap plate about its own vertical axis, said roller constituting the sole means for restraining the article against revolution about the axis of rotation of the lap plate, and means for adjusting the position of said support radially of the lap plate.

4. In an apparatus for simultaneously lapping annular surfaces provided on shoulders formed on a pair of articles having stem portions concentric with the shoulders and projecting therebeyond and having exterior cylindrical surfaces above the shoulders, the combination set forth in claim 3 wherein said arms are independently adjustable on said support and means common to said arms for clamping the same in any desired position of radial and circumferential adjustment relative to the lap plate.

5. The combination set forth in claim 3 wherein each of said arms is formed with an elongated slot therein, a clamping stud common to said arms and projecting through the slots formed therein, said stud being formed with a clamping head thereon, and means for moving said clamping stud toward and away from said support from a position of release to a locked position wherein the head of the stud serves to clamp said arms together and against a portion of said support.

6. A work holding fixture designed for use in connection with an annular lap plate having inner and outer concentric circular grooves formed therein, each adapted to receive therein the downwardly projecting stem portion of an article having an annular shoulder surrounding the stem portion with the shoulder being supported in lapping relationship on the plate on the rim portions of the groove on the opposite sides of the latter; said fixture comprising a spindle having a socket formed in the lower end thereof, a rod slidably and turnably disposed within said socket, a clamping stud projecting downwardly from the lower end of said rod and having an enlarged head thereon, a pair of laterally extending arms each having a slot formed therein carried at the lower end of said spindle, said arms overlapping each other so that the slots therein are in at least partial register, said stud projecting through said slots with the head thereof underlying the lowermost arm, there being a slot formed in the side of said spindle exposing a side of said rod, an operating pin secured to said rod and projecting laterally outwardly through said slot, said rod being movable between a lowered position within said socket wherein the head on said stud releases said clamping arms for adjusting purposes to an elevated position wherein said head of the stud is drawn tightly against the underneath side of the lowermost arm to clamp the latter against the uppermost arm and in turn to clamp the latter against the lower end of the spindle whereby said arms are locked in their adjusted positions, said slot being formed with a lateral offset notch designed for reception therein of said operating pin, the position of said notch with respect to the slot being such that when the operating pin is received within the notch said rod is in its elevated position, and a roller mounted on each arm for free rotation about a vertical axis, the combined extent of said arms being such that they may be adjusted to position said rollers in overlying relation with respect to said concentric grooves in the lap plate respectively when said spindle is positioned above the lap plate in a vertical position.

7. A combined work holding fixture and wear ring assembly designed for use in connection with an annular lap plate having inner and outer concentric circular grooves formed therein, each adapted to receive therein the downwardly projecting stem portion of an article having an annular shoulder surrounding the stem portion with the shoulder being supported in lapping relationship on the plate on the rim portions of the groove on opposite sides of the latter, said articles each having a cylindrical side surface; said assembly comprising an annular wear ring presenting a downwardly facing annular wear surface adapted to be positioned loosely on the lap plate with said wear surface resting on said rim portions, a yoke member extending across said wear ring above the latter and secured at its ends to the ring, a spindle extending centrally and vertically through said yoke member and on which said wear ring is rotatably mounted and on which it is vertically slidable, a pair of arms mounted on said spindle at the lower end thereof and spaced above the lap plate, said arms being independently adjustable radially on said spindle, means common to said arms for clamping the same in any desired position of radial adjustment, and a roller mounted on each arm for rotation about a vertical axis and adapted to be positioned for running engagement with the cylindrical surface on one of said articles so as to hold the same against circumferential movement on the lap plate and bias the article so that the stem portion thereof will bear against one side of the groove in which it is mounted whereby said side will induce rotation of the article.

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