April 15, 1958 R. O. SHURSON 2,830,412

WORK HOLDER FOR LAPPING MACHINES

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FIG. 1

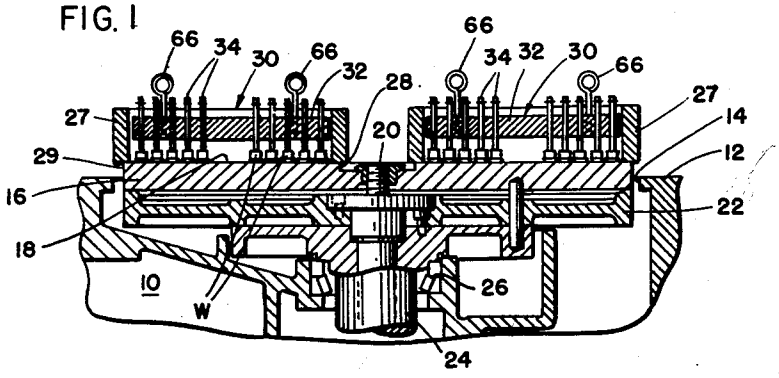


FIG. 2

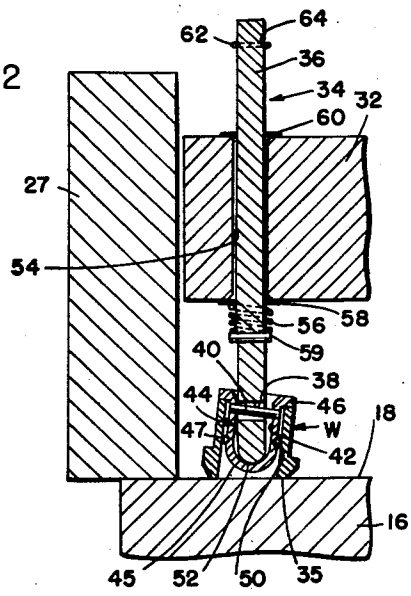


FIG. 4

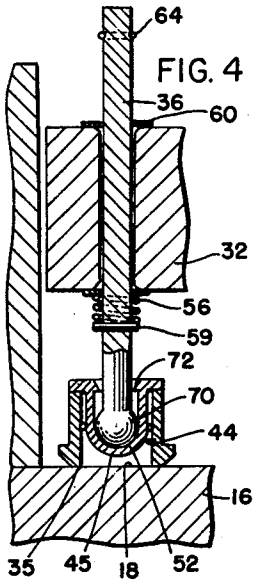
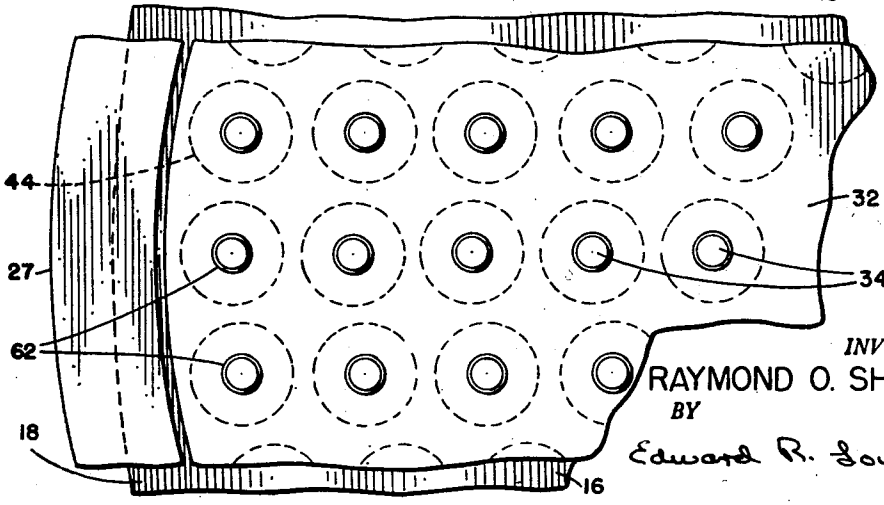


FIG. 3



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WORK HOLDER FOR LAPPING MACHINES

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4 Claims. (Cl. 51—227)

The present invention relates to work holders and more particularly to a means for supporting pieces of work on a flat abrading tool such as a lap plate while the work is being operated upon by the latter.

The improved work holder comprising the present invention has been designed for use primarily in connection with the application of work pieces to the annular rotatable lap plate associated with lapping machines of the type shown and described in the reissue patent to Bullard, Re. 23,937, dated February 8, 1955, for Lapping Machine. The invention is however capable of use in connection with other types of lapping machines and the same may, if desired, readily be employed, with or without suitable modification, for supporting work pieces on a flat lap surface which moves in its own plane and against which the work is adapted to frictionally bear for abrading respective surfaces on the work which is thus supported.

In the form of lapping machine illustrated in the above mentioned patent to Bullard, a series of articles are adapted to be loosely positioned on the rotating lap surface and pressed thereagainst by means of a pressure pad which overlies the various articles and, by its engagement with the upper regions of the articles, exerts a downward force on the articles tending to increase the degree of frictional contact between the articles and the lap surface which slides beneath the same. This method of holding the articles on the lap surface is quite satisfactory for small parts which do not possess appreciable height and which are more or less uniform in vertical thickness and which also have surfaces undergoing lapping which are normal to the vertical axes of the various articles. However, where the articles possess considerable height or where the surfaces on the articles undergoing lapping are at an angle or where the work otherwise is "top heavy," it has ben found that the force of friction, acting at a considerable distance from the plane of support, may cause a tilting movement of the article, leading either to complete dislodgement of the article from the lap surface or to a gouging of the lap surace and consequent termination of the lapping function. The present invention is designed to overcome the above noted limitations that are attendant upon the use of conventional holding means for an article on a lap surface and toward this end it contemplates the provision of a work holding and pressure applying means which will contact the article at an effective pressure applying region which is sufficiently close to the region of application of force by the article to the lap plate that the article will possess a degree of stable equilibrium on the lap surface regardless of the overall height of the article and regardless of whether the surface on the article which is to be lapped is normal or is at an angle to the vertical.

The provision of a work holder of the character briefly outlined above being among the principal objects of the invention, a further object is to provide such a work holder which is capable of ease of application to an individual article undergoing lapping and easy removal

therefrom after lapping operations have taken place.

Another object of the invention is to provide a work holder of this sort which is readily adaptable to multiple use on a single lap plate, which is to say that a number of the work holders may be applied to the respective articles, whether the articles be of a uniform nature or whether they be of different configurations, and the various articles, with the work holders applied thereto, operatively positioned upon the lap surface in such a manner that the weight of a single pressure applying member may be distributed through the various work holders to the articles supported thereby, thus insuring substantially equal pressure at the various points of application of pressure to the articles.

Yet another object of the invention is to provide a work holder of this character which is self-compensating for work pieces having different characteristics so that the same may, without any adjustment whatsoever of the parts thereof, be applied to these different work pieces and, when so applied, maintain the surfaces of the work pieces squarely on the lap surface during lapping operations.

Still another object of the invention, in a modified form thereof, is to provide a work holder which will maintain the article in frictional contact with the surface of a rotating lap surface while at the same time allowing free rotational movement of the article about its own axis due to induced friction between the article and the lap surface.

The provision of a work holder of this type which is extremely simple in its construction and which is possessed of a minimum number of essential parts and which therefore is unlikely to get out of order; one which will accommodate a large variety of articles and which therefore is versatile in its use; one which may be manufactured at a low cost, and one which otherwise is well adapted to perform the services required of it are further desiderata which have been borne in mind in the production and development of the present invention.

In the accompanying single sheet of drawings, forming a part of this specification, two embodiments of the invention showing the same operatively applied to the lap surface of a lapping machine of the type shown in the above mentioned patent to Bullard have been illustrated.

In these drawings:

Fig. 1 is a fragmentary sectional view taken substantially centrally and vertically through the lap plate of a lapping machine and showing a number of the improved work holders comprising the present invention operatively installed thereon.

Fig. 2 is an enlarged detail sectional view of a portion of the structure shown in Fig. 1 and illustrating the operation of one of the present work holders.

Fig. 3 is an enlarged fragmentary top plan view of the structure shown in Fig. 1, and

Fig. 4 is a sectional view similar to Fig. 2 showing a modified form of work holding apparatus.

Referring now to the drawings in detail, a fragmentary portion of a lapping machine of the type shown in the above mentioned patent to Bullard has been illustrated in Fig. 1 and includes a stationary framework **10** providing a table portion **12** having a central circular opening **14** formed therein in which opening there is rotatably disposed a lap plate **16** having an annular lap surface **18** facing upwardly thereon. The lap plate **16** is secured by means of a central stud **20** to a rotatable supporting spider **22** carried at the upper end of a vertical drive shaft **24** suitably carried in the framework by means of antifriction bearings **26**.

In order to maintain the contour of the lap surface **18** substantially flat and to eradicate the wearing action of

the work on this surface, a plurality of wear rings 27 are loosely positioned on the lap surface and are of such overall diameter that they overlap both the inside and outside peripheral edges 28 and 29 respectively of the lap plate 16. These rings may be held against revolution about the central vertical lap axis of the lap plate by suitable means (not shown) as for example the means disclosed in the above mentioned patent to Bullard or in the patent to Roshong, No. 2,627,144, dated February 3, 1953, for Lapping Machine, while at the same time they are capable of induced rotation about their respective vertical axes by virtue of the frictional differential existing at radially displaced regions of the lap surface.

The arrangement of parts thus far described is conventional in its design 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 more fully described and claimed.

The work pieces to be lapped are preferably applied to the lap surface within the confines of the various wear rings 22 for space conservation purposes and a relatively large number of the pieces may be accommodated within each ring by means of one of the work holding assemblies of the present invention, two such assemblies being shown in Fig. 1 and designated individually in their entirety at 30. Each assembly involves in its general organization a circular pressure member or weight 32 and a number of cooperating work-engaging spindle units 34 the nature and function of which will be set forth in detail presently.

The work pieces W selected for illustration are in the form of valve parts which may constitute the operative valve elements of a gate valve assembly and which are generally of tubular configuration and have annular valve surfaces 35 which are at a slight variance with a plane normal to the axis of the piece W. Each work piece W is held upon the lap surface 18 by means of one of the spindle units 34 carried by the pressure member or weight 32.

In the form of the invention shown in Fig. 2 the spindle unit 34 includes an elongated spindle, stem or rod 36 the lower end of which is formed with a transverse opening 38 therethrough. A pin 40 of a diameter considerably smaller than the diameter of the opening 38 projects completely through the opening 38 and has its opposite ends anchored at diametrically opposed points on the cylindrical wall 42 of a cup-shaped adaptor 44 having a rounded bottom 45 and a laterally flanged upper rim 46. The cylindrical wall 42 of the adaptor 44 has an outside diameter slightly less than the internal diameter of the part W and when the adaptor is inserted telescopically within the part W as shown in Fig. 2, the adaptor is frictionally held in its telescopic relation within the part by means of a resilient O ring 47 which is interposed between the wall 42 and the inner surface of the part W and which seats within an annular groove 50 extending around the wall 42. The combined height of the cylindrical wall 42 and rounded bottom 45 of the adaptor 44 is less than the overall height of the part W so that when the adaptor is received within the part with the flange 46 resting on the upper rim of the part W, the lowermost point on the bottom 45 of the adaptor will clear the lap surface 18. The spindle 36 has its lower end rounded as at 52 so that it may make point contact with the upwardly facing surface of the rounded bottom 45 of the adaptor 44 when the spindle 36 is forced downwardly under the influence of the weight 32.

In order to exert a downward thrust upon the spindle 36 the weight of the pressure member 32 is distributed upon the various spindle units 34 which are associated with the pressure member 32. Accordingly, a plurality of vertical bores 54 are formed in the pressure member 32 at spaced regions thereabout and each bore 54 is adapted to receive completely therethrough one of the spindles 36 associated with a respective unit 34. A portion of the weight of the pressure member 32 is applied to each spindle 36 by means of a spring and washer assembly 56, 58 which surrounds the spindle. The lower end of the spring 56 is supported upon a pin 59 which extends through the spindle 36 and the upper end of the spring bears against the washer 58 which in turn bears against the underneath surface of the pressure member 32. The spindle 36 is prevented from falling completely through the bore 54 when the pressure member 32 is elevated by means of a washer 60 surrounding the spindle and which is designed for engagement with a snap ring 62 carried in a groove 64 near the upper end of the spindle.

In order to facilitate removal of the entire work holding assembly 29 together with the various spindle units and the work to which they are applied, each pressure member 32 carries a pair of spaced eyelets 66, the shank portions of which are threadedly received in sockets provided in the pressure members.

In actual practice, where a number of the parts W are to be lapped, they may be loaded onto the work holding assemblies 29 in any convenient manner, consideration being given to an equitable distribution of the parts around the surface 18 on the lap plate 16. The assemblies 29 may be removed from the machine and placed upside down on a suitable holder so that the individual parts W may be manually telescoped over the cup-shaped members 44 on the ends of the spindles 36 with the various O rings 47 serving to retain the pieces W in their home position wherein the rims thereof engage the flanges 46 of the cups. Utilizing the eyebolts 66 as carrying members, the entire unit may then be placed within the wear ring 27 so that they will assume the positions shown in Fig. 1 wherein all of the pieces W rest upon the surface 18 of the lap with the annular faces 35 thereof in face-to-face contact with the lap surface. The entire assembly may thus be said to be floatingly mounted within its respective wear ring 27 so that during operation of the machine the assembly will be free to rotate relative to the lap surface under the influence of frictional forces developed between the various pieces W and the lap surface as well as due to the tendency for the induced rotation of the wear ring 27 to be transmitted to the pressure member 32 by direct contact between these two parts. As lapping progresses each part W describes an epicycloidal movement about the surface of the lap, revolving about the central axis of the pressure plate but being restrained against revolution about the axis of the lap plate by virtue of the holding means which restrains the wear rings 22 from such revolution. It is to be noted at this point that the weight of the pressure member 32 is more or less equally distributed through the springs 56 and spindles 36 to the work pieces W. Since the diameter of the transverse bore 38 in each spindle 36 is considerably larger than the diameter of the pin 40, the portion of the weight of the pressure member 32 which is allocated to any particular spindle 36, plus the weight of the spindle and the assembly of which it constitutes a part, is applied to the work piece at the point 52. Since this point is relatively close to the plane of the lap surface and is well below the center of the work piece W, a degree of stable equilibrium which has hitherto been unobtainable where relatively tall work pieces are concerned, is effected so that there will be no tilting of the work piece and consequently no gouging of the lap plate.

In the form of the invention shown in Fig. 4 a slightly modified form of work holding spindle unit 34 has been illustrated. In this form of the invention the pressure member 32 and the manner in which the spindle 36 is slidably secured within the bore 54 of the pressure member remain substantially the same as in the form of the invention previously described. However, the cup member 44 is maintained in position at the lower end of the spindle by means of the provision of an enlargement 70 at the lower end of the spindle. This enlargement provides the point of contact 52 with the inner surface of

the cup bottom **45** and the lower end of the spindle is prevented from being withdrawn from the cup **44** by staking the rim of the cup opening inwardly as shown at **72**. In this form of the invention the transverse bore **38** and cross pin **40** have been omitted so that the cup member **44** is free to rotate about its own vertical axis relative to the spindle **36**. Otherwise the essential features of the invention as illustrated in Fig. 2 are fully preserved. The form of the invention show in Fig. 4 may be employed in connection with parts having surfaces which are at slight divergence with the plane normal to the axis of the part. However, it is best adapted for use with pieces whose lapped surfaces have no such divergence and which are substantially normal to the axis of the shaft. When thus employed, the piece W is capable of being independently rotated upon the ends of the spindles **36** by virtue of the induced rotation imparted to them and existing by reason of different frictional characteristics existing at radially spaced points on the lap surface.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. For example, while the work holding assemblies **30** have been shown as being loosely disposed within their respective conditioning rings **22** so that they will tangentially engage the inner peripheries of the various wear rings, these assemblies may be self-centered on a suitable central spindle or other support so that they will be maintained out of contact with the wear rings **22**. Only insofar as the invention has been particularly pointed out in the accompanying claims is the same to be limited.

What I claim is:

1. A work holder for a plurality of work pieces each having a cylindrical bore formed therein providing an upwardly facing rim, and a generally flat and transverse outwardly facing exposed surface designed to be lapped to a high degree of flatness by application thereof to a flat lap, said work holder comprising a pressure plate having a plurality of openings therein, a cup-shaped adaptor for each work piece, said adaptor extending into the bore and bearing against the work piece, friction means holding the work piece and adaptor together, a stem on each adaptor extending into the openings in the pressure plate, and yieldable means supporting the pressure plate from the stems.

2. A work holder as described in claim 1, the friction means comprising an O ring of resilient material encircling the adaptor and compressed thereagainst by the cylindrical bore.

3. A work holder for a hollow work picee to be lapped, said holder comprising a cup-shaped adaptor having a part extending into the work piece, resilient compressible means on the adaptor for engagement with the work piece and by which the work piece may be carried, a hemi-spherical bottom wall on the adaptor, a spindle extending into the adaptor and contacting the hemispherical bottom wall with a universal movement and means for revolving the spindle in a circular path.

4. A work holder for a plurality of hollow work pieces to be lapped, said holder comprising cup-shaped adaptors each having a part extending into a work piece, resilient compressible means on each adaptor for engagement with the work piece and by which the work piece may be carried, spindles extending into each adaptor and contacting said work piece with a universal movement, a plate having openings therethrough to receive the spindles, means for supporting the plate from the spindles, and a rotatable wear ring surrounding the plate and adapted to impart a rotary motion to the plate.

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