Sept. 7, 1954 R. G. ROSHONG ET AL 2,688,215

DOUBLE LAP FOR LAPPING PARALLEL FACES

Filed May 4, 1951 3 Sheets-Sheet 1

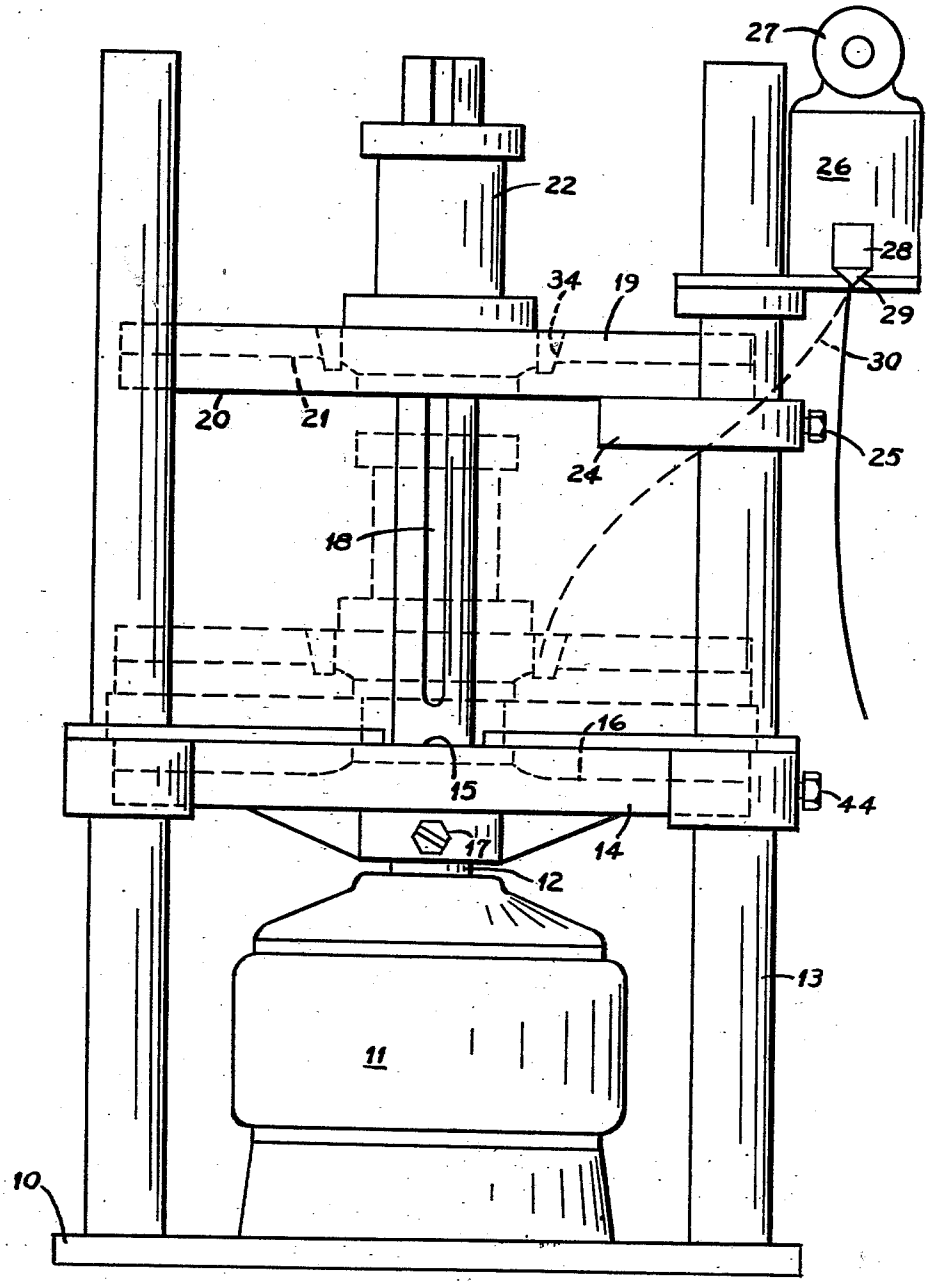


Fig. 1

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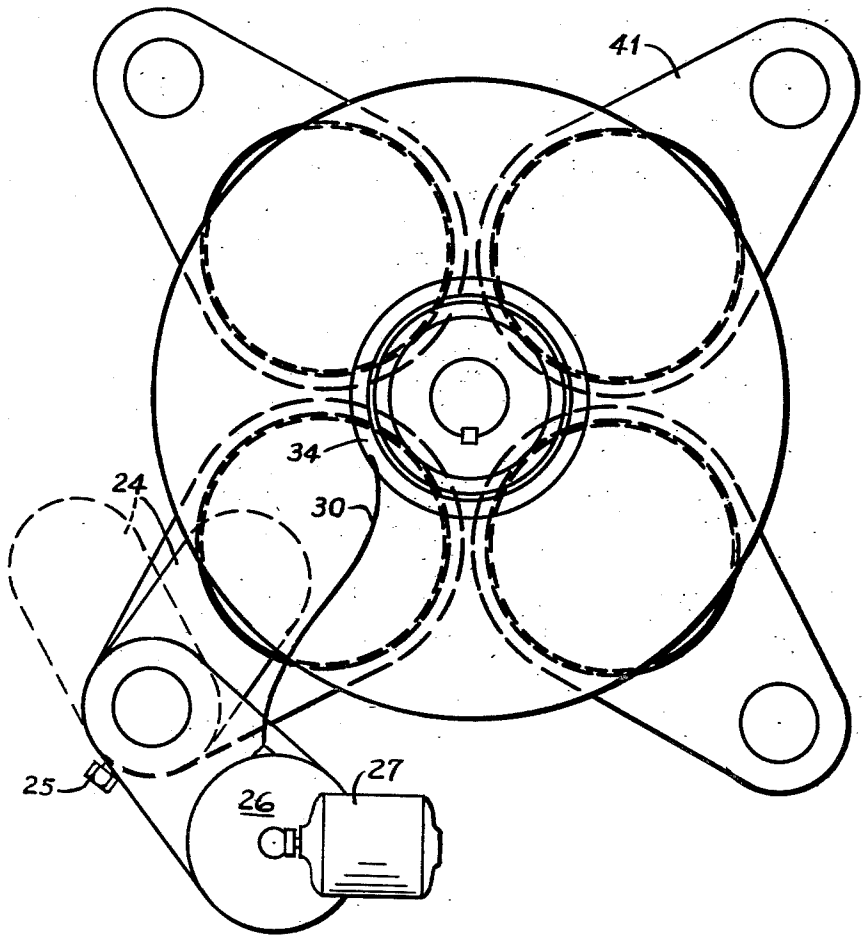


Fig. 2

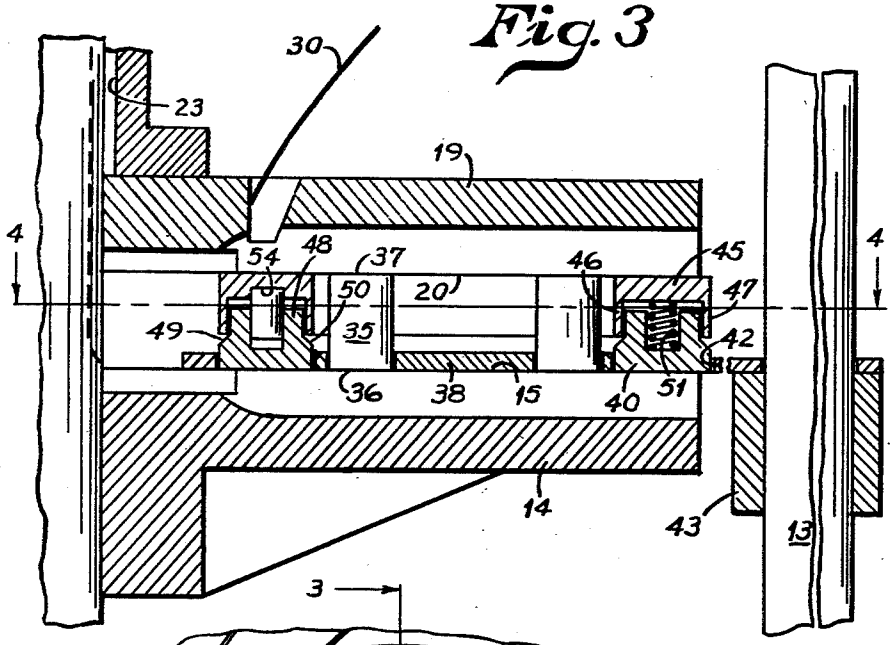
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DOUBLE LAP FOR LAPPING PARALLEL FACES

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Fig. 3



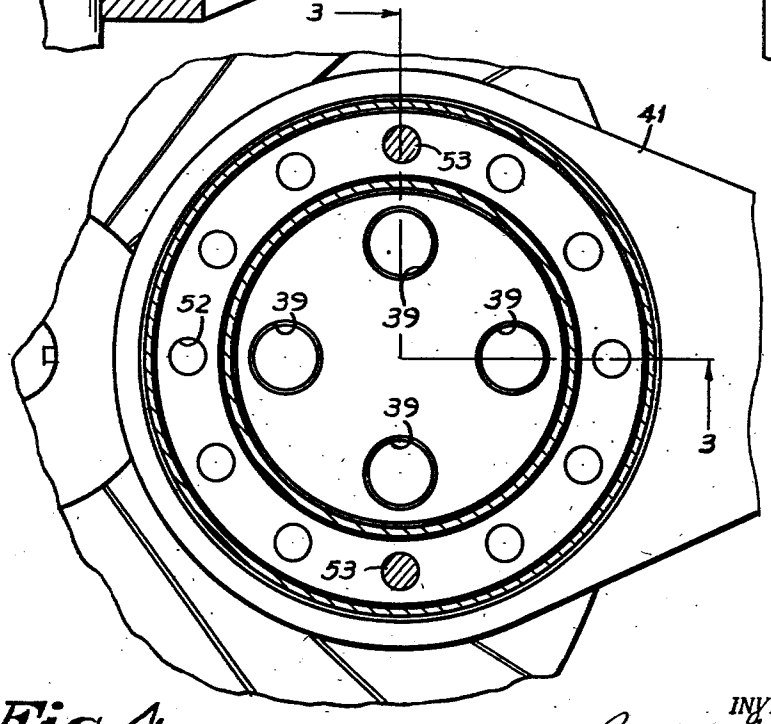


Fig. 4

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UNITED STATES PATENT OFFICE

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DOUBLE LAP FOR LAPPING PARALLEL FACES

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Application May 4, 1951, Serial No. 224,524

11 Claims. (Cl. 51—118)

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This invention relates to machines for finishing metal such as grinding and lapping machines, and particularly to a machine for finishing opposite surfaces of an article to a high degree of parallelity.

There is available at the present time a lapping machine which is provided with means for continuously dressing the lap while the machine is in use. Such an arrangement increases the production obtainable from a machine in any given time since no time is lost dressing the machine. The lap used is annular and the continuous dressing means is comprised of a ring the internal diameter of which is approximately equal to the radial dimension of the annular lap. The ring rests on the lap of its own weight and is induced to rotate on the lap surface by the rotation of the lap, the continuous rotation of the ring causing an abrading action to take place on the lap surface to keep it dressed. The ring has considerable mass and is rigid; by properly locating the ring on the lap, the surface of the lap can be maintained either flat, concave or convex indefinitely. The articles to be lapped may be placed within the ring or they may be held on the lap with a separate work holder.

Although it is possible to lap opposite faces of an article to a high degree of parallelity with the above described apparatus, it is a relatively slow process since each face must be lapped separately.

The principal object of this invention is to provide an apparatus for simultaneously lapping opposite faces of an article to a high degree of parallelity while continuously dressing the laps.

A more specific object of this invention is the provision of a continuous dressing means for two opposed laps, said means being adapted to exert a pressure upon both laps for the dressing operation, without depriving the articles of the required pressure from both laps.

A still more specific object of this invention is the provision of a dressing means for two opposed laps, said means comprising a pair of concentric rings, each adapted to dress one lap, with resilient means between them for maintaining the rings in contact with their respective laps.

In the operation of a lapping machine it is necessary to apply lapping compound to the surfaces of the lap. The preferred method is to allow the compound to flow down a conducting wire from an agitated supply tank to the surface of the lap. In the present invention, one lap is preferably located above the other so that the upper lap is inverted and it becomes difficult to maintain a sufficient supply of lapping compound on the upper surface.

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Another object of this invention is to provide means in the upper lap of a double lap by which lapping compound is continuously and uniformly distributed over the operative surface of the upper lap.

These and other objects of this invention will become apparent from the following detailed description when taken together with the accompanying drawings, in which

Fig. 1 is an elevation of a lapping machine incorporating the double lap of this invention;

Fig. 2 is a plan view of the double lap of this invention;

Fig. 3 is an enlarged section through the double lap and the split wear ring; and

Fig. 4 is a section taken along lines 4—4 of Fig. 3.

Referring now to Fig. 1, there is shown a base 10 upon which is mounted a suitable motor and reduction gear 11 which drives a shaft 12 disposed vertically with respect to base 10. Also mounted on base 10 are posts 13 which are four in number in the embodiment chosen here for illustrating the invention. The number of posts may vary in accordance with the number of work stations desired for the machine. Said posts are preferably circular in cross section and extend a considerable distance above base plate 10. Shaft 12 drives a circular lap 14, the upper surface 15 of which is the operative lap surface. This surface is preferably annular in form and is provided with a plurality of radially disposed serrations 16, the function of which is to remove the material abraded from the articles being lapped and also to remove excess lapping compound. Lap 14 is preferably secured for rotation with shaft 12 by means of a setscrew 17 or the like, it being immaterial to this invention which means is employed for this purpose.

Shaft 12 also extends vertically a considerable distance above base plate 10 and is provided with a long key 18. Mounted above lap 14 is a similar lap 19, the lower surface 20 of which is a lapping surface and is likewise annular in form. Lapping surface 20 is serrated as shown at 21 with radially disposed serrations which function in the same manner and for the same purpose as the serrations 16 in lap 14. A relatively long hub 22 is formed either integrally with lap 19 or is rigidly secured thereto, said hub 22 having a close fit on shaft 12 and having a keyway therein (Fig. 3) 23 in which key 18 is received. For extremely precise work, hub 22 is lapped on shaft 12 so as to minimize lost motion or play therebetween and to promote smooth movement of lap 19 along shaft 12.

It is apparent thus far that laps 14 and 19, being secured for rotation to shaft 12, will rotate in the same direction. It is also apparent that lap 19 may move axially on shaft 12 toward and away from lap 14. Thus the spacing between the laps may be determined solely by the height of the articles to be lapped.

To facilitate the operation of the machine, a movable support is provided for lap 19, said support taking any convenient form such as an apertured bar 24 encircling a post 13 to which it may be clamped. The position of bar 24 on post 13 may be adjusted vertically and horizontally by raising and lowering the bar on the post 13 or by swinging the bar 24 horizontally to the position shown in Fig. 2. When the bar 24 is swung under lap 19, its position may be fixed by a setscrew 25 so as to form a support for lap 19 while articles are placed upon or removed from the lap surface 15. Thus to lower lap 19 so that its lap surface 20 may rest upon the articles to be lapped, lap 19 is held in a raised position while setscrew 25 is loosened so as to permit bar 24 to be swung out of the way of lap 19. Said lap may then be lowered past the bar 24 to its working position.

During the lapping operation, it is necessary to supply both lap surfaces 15 and 20 with suitable lapping compound. This compound is supplied from a tank 26 in which is an agitator (not shown) driven by a motor 27. A similar tank, agitator and drive motor are shown in a copending application of Earl J. Bullard, Serial No. 14,619, filed March 12, 1948, now Patent No. 2,565,590, dated August 28, 1951. The compound is then fed through a suitable valve 28 to a trough 29 which terminates in a feed wire 30. The compound then flows along the outside of wire 30 to the laps. Said wire 30 is flexible and hence may be bent out of the way of lap 19 when said lap is raised relative to tank 26.

When the machine is in operation, wire 30 is bent so as to terminate in a trough 34 formed in the upper surface of lap 19. Said trough 34 is deep enough to intercept the radial serrations in lap surface 20. This provides a path for the compound from trough 34 through the serrations 21 to the upper lap surface 20. From there the compound is distributed by the operation of the machine over the parts to be lapped and over the wear rings, hereinafter to be described, and then down to the upper surface 15 of lower lap 14.

Referring now to the remaining figures, and particularly to Fig. 3, the articles to be lapped are shown at 35 and may comprise prisms, cylinders or other articles having opposite surfaces which must be lapped with a high degree of parallelity. There are many such articles used in industry, one of the most common being guage blocks used as standards in various manufacturing operations. For illustrative purposes, the articles shown are cylinders. Thus the surfaces to be abraded in cylinders 35 are surfaces 36 and 37, surface 36 resting upon lap surface 15, and surface 37 being contacted by lap surface 20. Said articles are preferably held in relatively fixed relation to one another by a work holder 38, which, in the present case, is a disc of any suitable material, either metallic or nonmetallic such as wood, hard rubber, synthetic resin, etc., and which is preferably readily expendable. Said work holder 38 has perforations 39 therein within which the cylinders 35 are received. The perforations 39 are preferably made larger than the articles 35 so that said articles can move freely in said perforations.

The work holder 38 is in turn held by a ring 40 which may be termed a conditioning or wear ring and which functions to maintain the lap surface 15 perfectly flat at all times. It removes material from lap surface 15 which is not removed by the articles 35 to maintain the lap surface 15 in its original condition throughout the lapping cycle. Said wear ring 40 in a simpler form is disclosed in the aforementioned patent to Earl J. Bullard. The material from which ring 40 is constructed is preferably a close grain cast iron, such as Meehanite. The wear ring 40 is in turn held on lap surface 15 by a stationary reaction plate 41 which has a circular opening 42 therein to receive ring 40 with a relatively loose fit to permit said ring 40 to rotate in opening 42 under the influence of the rotating lap surface 15. Said plate 41 is secured to a sleeve 43 which fits over a post 13 and is secured thereto by a setscrew 44. Plate 41 may be rotated about post 13 to locate ring 40 at any desired radial position on lap surface 15. It has been found that the conditioning or dressing action of ring 40 is dependent to a large extent upon the location of the ring 40 on lap surface 15. Thus, it is possible to cause flat surface 15 to become convex by locating ring 40 closer to the outer periphery of the lap surface 15 than to the inner periphery. It has also been found that lap surface 15 may be made concave by locating ring 40 closer to the center of lap surface 15. The maintenance of lap surface 15 in a perfectly flat condition therefore requires that plate 41 be adjustable so that the optimum position of ring 40 on lap surface 15 for flat lapping may be secured. Once the position is determined for a given article, no further adjustments need be made.

It is clear that if a continuous lapping cycle is to be had from the double lap shown, it will be necessary to provide a conditioning means for said upper lap 20 which will function in the same manner as ring 40. Due to the fact that the distance between the laps varies not only as between articles, but also as the articles are lapped, a certain degree of flexibility in the mounting of the ring is required.

In the form chosen for illustration herein, the conditioning ring for upper lap surface 20 is comprised of a ring 45 (Fig. 3) having flanges 46 and 47 extending downwardly from the inner and outer peripheries thereof, respectively. Said flanges in the ring 45 give the ring 45 rigidity and also serve to center the ring 45 around ring 40. Ring 40 has a narrower upper portion 48 which is joined by sloping shoulders 49 and 50 to the outer and inner surfaces respectively of ring 40. Thus when ring 45 is mounted over ring 40 so that the flanges 46 and 47 telescope over the narrower portion 48 of ring 40, said ring 45 will be retained on ring 40 and will be constrained to move with it. Although two flanges are shown, it is obvious that one flange may be sufficient to hold ring 45 in ring 40.

The wear characteristics of ring 45 are also dependent upon the pressure exerted by ring 45 upon lap surface 20. This pressure in the form herein illustrated is the difference between the downward pressure exerted by the weight of lap 19 and the sum of the pressures exerted upward by the articles 35 and by a plurality of springs 51 located in a circular recess 52 in the upper surface of ring 40. One or more pins 53 may be provided in ring 40 and extending into a shallow circular recess 54 in ring 45 to prevent relative rotation between rings 40 and 45. If

the pressure on the articles 35 is to be considerably less than the weight of lap 19, then springs 51 are so selected as to bear the greater portion of the weight of the lap. This pressure is in turn transmitted through the springs 51 to ring 40 and through ring 40 to surface 15 of disc 14. It is apparent that the pressure between ring 40 and lower lap surface 15 will be greater than the pressure between ring 45 and the surface 20 of the upper lap by the weight of the two rings and their associated springs 51 and drive pins 53.

As shown in Fig. 2, four work stations may be used simultaneously, each one being anchored by a post 13. Each work station in turn is comprised of a plate 41, wear rings 40 and 45, and work holder 38. Each of these work stations may be loaded simultaneously, and after the articles are lapped they can likewise be unloaded at the same time. The operating cycle will vary with the articles as well as the compound.

In operation, the upper lap 19 is raised and support 24 is rotated under the raised lap to support the lap in an elevated position. Articles 35 are then placed in the perforations 39 in work holder 38 and then support 24 is rotated out of the way of lap 19, which is subsequently lowered until it contacts the rings 45 and the upper surfaces 37 of the articles to be lapped. Wire 30 is then swung over above groove 34 and the compound is permitted to run down the wire into said groove. Motor 11 is then started which rotates shaft 12 and the two laps 14 and 19 with their lapping surfaces 15 and 20 contacting surfaces 36 and 37, respectively, of the articles. Since the surfaces are rotated in the same direction, they will induce a rotation in rings 40 and 45 in the same direction which in turn will be transmitted to the work holder 38 finally to the articles 35. Thus the articles will be lapped by the surfaces 15 and 20 while the said surfaces 15 and 20 are being conditioned by the rotating rings 40 and 45. Inasmuch as the laps rotate in the same direction, there is no turning moment produced in the articles and therefore there is no tendency for the articles to tip in their supporting work holder 38. If they do not tip, then there is no possibility of the surfaces 36 and 37 being lapped nonparallel.

After a predetermined length of time after the lap operation has commenced, the motor 11 is stopped, wire 30 is bent out of the way as shown in Fig. 1, and lap 19 is raised and made to rest upon its supporting bar 24. The finished work is then removed from the fork holders and other articles to be lapped are inserted therein, whereupon the cycle may be repeated.

Although it is not essential for good results to have a long hub 22 and lap 19, nevertheless such a hub tends to constrain lap 19 to a position normal to the axis of shaft 12 which is the ideal position for parallel lapping. Hub 22 may be made shorter, or in fact eliminated entirely, where the degree of precision is not required to be of the highest.

It is understood that the foregoing description is illustrative of a preferred embodiment of this invention and that the scope of the invention is not to be limited thereto, but is to be determined by the appended claims.

What is claimed is:

1. In a lapping machine for simultaneously lapping the opposite faces of articles, a pair of lapping elements mounted for rotation about a common axis and relatively movable toward and away from each other and having opposed lapping surfaces adapted to receive therebetween articles to be lapped with their opposite faces in contact with said lapping surfaces, means for producing relative movement between the lapping elements and the articles undergoing lapping, and a resilient expansible conditioning member positioned between said lapping elements and surrounding the articles and having opposite surfaces bearing in opposite directions against said lapping surfaces for conditioning the latter during lapping operations upon said articles, said conditioning member being expansible through a range of thicknesses including the thickness of the articles undergoing lapping.

2. In a lapping machine for simultaneously lapping the opposite faces of articles, a pair of lapping elements mounted for rotation about a common axis and relatively movable toward and away from each other and having opposed lapping surfaces adapted to receive therebetween articles to be lapped with their opposite faces in contact with said lapping surfaces, means for producing relative movement between the lapping elements and the articles undergoing lapping, and expansible means positioned between said lapping elements and surrounding the articles and bearing in opposite directions against said lapping surfaces for conditioning the latter during lapping operations upon said articles.

3. In a lapping machine for simultaneously lapping the opposite faces of articles to a high degree of parallelism, upper and lower abrasive laps, means for mounting said laps for rotation about a common vertical axis and while permitting relative movement between the laps toward and away from each other, said laps being adapted to receive therebetween articles to be lapped with their opposite faces in contact with the laps, means for rotating said laps, a reaction plate disposed between said laps, means holding said reaction plate in a fixed position, there being a circular opening in said reaction plate, and a conditioning ring assembly loosely disposed within said opening, said assembly including upper and lower conditioning rings proper bearing against the upper and lower laps respectively, and a series of compression springs disposed between said conditioning rings and serving to normally spread the same apart and urge the same into an engagement with their respective laps.

4. In a lapping machine for simultaneously lapping the opposite faces of articles to a high degree of parallelism, upper and lower co-extensive circular laps, means for mounting said laps for rotation about a common vertical axis while permitting relative movement between the laps toward and away from each other, said laps being adapted to receive therebetween articles to be lapped with their opposite faces in contact with the laps, means for rotating said laps in the same direction, a reaction member projecting into the space existing between said laps, means holding said reaction member in a fixed position, there being a vertical bore formed in said member, a conditioning ring shaped and sized to fit loosely in and projected completely through the bore in said reaction member and having upper and lower lap-dressing surfaces designed for contact with the upper and lower laps respectively, a work holder shaped and sized to fit loosely within said conditioning ring and having work receiving openings therein, said conditioning ring being free to rotate relatively to the lap surfaces under the influence of fric-

tional forces developed between the ring and lap surfaces.

5. In a lapping machine for simultaneously lapping the opposite faces of articles to a high degree of parallelism, upper and lower co-extensive circular ring-like laps, means for mounting said laps for rotation about a common vertical axis while permitting relative movement between the laps toward and away from each other, said laps being adapted to receive therebetween articles to be lapped with their opposite faces in contact with the laps, means for rotating said laps in the same direction, a reaction member projecting into the space existing between said laps, means holding said reaction member in a fixed position, there being a vertical bore formed in said reaction member and of a diameter greater than the width of said lap in a radial direction, a conditioning ring shaped and sized to fit loosely in and project through the bore in said reaction member and having upper and lower lap-dressing surfaces designed for contact with the upper and lower laps respectively, a work holder shaped and sized to fit loosely within said conditioning ring and having work receiving openings therein.

6. In a lapping machine for simultaneously lapping the opposite faces of articles to a high degree of parallelism, upper and lower co-extensive circular ring-like laps, means for mounting said laps for rotation about a common vertical axis while permitting relative movement between the laps toward and away from each other, said laps being adapted to receive therebetween articles to be lapped with their opposite faces in contact with the laps, means for rotating said laps, a reaction member projecting into the space existing between said laps, means holding said reaction member in a fixed position, there being a vertical bore formed in said reaction member and of a diameter greater than the width of said lap in a radial direction, a lower conditioning ring shaped and sized to fit loosely in said bore and having a lower lap dressing surface designed for contact with the lower lap, an upper conditioning ring having an upper lap dressing surface designed for contact with the upper lap, and means disposed between said conditioning rings for normally urging the same apart in opposite directions to force their respective dressing surfaces into engagement with the respective laps, and a work holder sized and shaped to fit loosely within said lower conditioning ring, there being a series of work receiving openings formed in said work holder.

7. In a lapping machine for simultaneously lapping the opposite faces of articles to a high degree of parallelism, upper and lower co-extensive circular ring-like laps, means for mounting said laps for rotation about a common vertical axis while permitting relative movement between the laps toward and away from each other, said laps being adapted to receive therebetween articles to be lapped with their opposite faces in contact with the laps, a reaction member projecting into the space existing between said laps, means holding said reaction member in a fixed position, there being a vertical bore formed in said reaction member and of a diameter greater than the width of said lap in a radial direction, a lower conditioning ring shaped and sized to fit loosely in said bore and having a lower dressing surface designed for contact with the lower lap, an upper conditioning ring having an upper-dressing surface designed for contact with the upper lap, a series of compression springs disposed between said conditioning rings and circumferentially spaced from each other and normally urging said rings apart to force the dressing surfaces thereof into engagement with the respective laps.

8. In a lapping machine for simultaneously lapping the opposite faces of articles to a high degree of parallelism, upper and lower co-extensive circular laps, means for mounting said laps for rotation about a common vertical axis while permitting relative movement between the laps toward and away from each other, said laps being adapted to receive therebetween articles to be lapped with their opposite faces in contact with the laps, a plurality of reaction members, means pivotally mounting said reaction members for swinging movement in a horizontal plane about respective vertical axes removed from the axis of rotation of the laps a distance greater than the radius of the laps, there being a circular opening in each reaction member, a conditioning ring having upwardly and downwardly facing lap dressing surfaces disposed within each bore and loosely fitting therein and having its upper and lower surfaces designed for engagement with the upper and lower laps respectively.

9. In a lapping machine for simultaneously lapping the opposite faces of articles to a high degree of parallelism, upper and lower co-extensive circular laps, means for mounting said laps for rotation about a common vertical axis while permitting relative movement between the laps toward and away from each other, said laps being adapted to receive therebetween articles to be lapped with their opposite faces in contact with the laps, a plurality of reaction members, means pivotally mounting said reaction members for swinging movement in a horizontal plane about respective vertical axes removed from the axis of rotation of the laps a distance greater than the radius of the laps, there being a circular opening in each reaction member, a conditioning ring having upwardly and downwardly facing lap dressing surfaces disposed within each bore and loosely fitting therein and having its upper and lower surfaces designed for engagement with the upper and lower laps respectively, and an article holder sized and shaped to loosely fit within each conditioning ring, there being a series of article-receiving openings formed in each article holder.

10. The combination with a lapping machine having opposed abrasive laps, means supporting said laps for rotation about a common axis and a plurality of reaction members projecting into the space existing between the opposed laps, means supporting said reaction members and preventing revolution thereof about said axis each reaction member being provided with a circular opening therein, of a plurality of conditioning devices each disposed within one of said openings and comprising a lower conditioning ring having an underneath face in contact with the lower lap and an upper conditioning ring telescopically received over the lower conditioning ring and having an upper face in contact with the upper lap, and a series of compression springs circumferentially spaced from each other and disposed between said conditioning rings and normally urging the same apart.

11. A lapping machine for simultaneously lapping the opposite faces of articles to parallelism, comprising a drive shaft mounted for rotation

about a vertical axis, means for rotating said drive shaft, a circular ring-like lower lap secured to said shaft and rotatable therewith, a circular ring-like upper lap keyed to said shaft and movable vertically toward and away from said lower lap, said laps being adapted to receive therebetween articles to be lapped with their opposite faces in contact with the laps, a plurality of vertically extending stationary posts positioned about the periphery of said laps and spaced outwardly therefrom, a reaction member adjustably secured to each post and capable of being projected between said laps, there being a vertical bore in each reaction member, a conditioning ring shaped and sized to fit loosely in and project through each bore, said conditioning ring including upper and lower lap dressing surfaces designed for contact with the upper and lower laps respectively, each of said laps being formed with a series of radial grooves in its article-engaging surface to receive the products of abrasion, a source of lapping compound, said upper lap being formed with an annular trough in its upper surface communicating through the lap with the radial grooves provided in the latter, and means for feeding compound from said source into said trough.

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