Sept. 7, 1943. G. F. JOHNSON 2,328,809

LAPPING MACHINE

Filed May 23, 1941 3 Sheets-Sheet 1

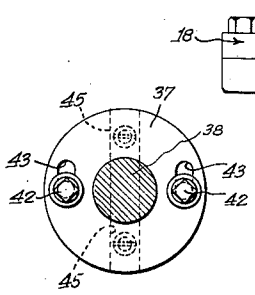


Fig. 6.

Fig. 1.

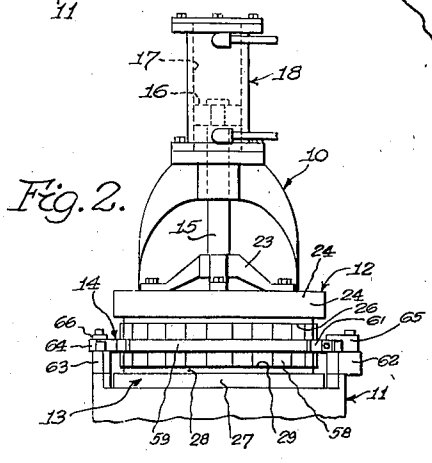


Fig. 2.

Inventor
Glen F. Johnson

By

Attorneys

Sept. 7, 1943. G. F. JOHNSON 2,328,809

LAPPING MACHINE

Filed May 23, 1941 3 Sheets-Sheet 2

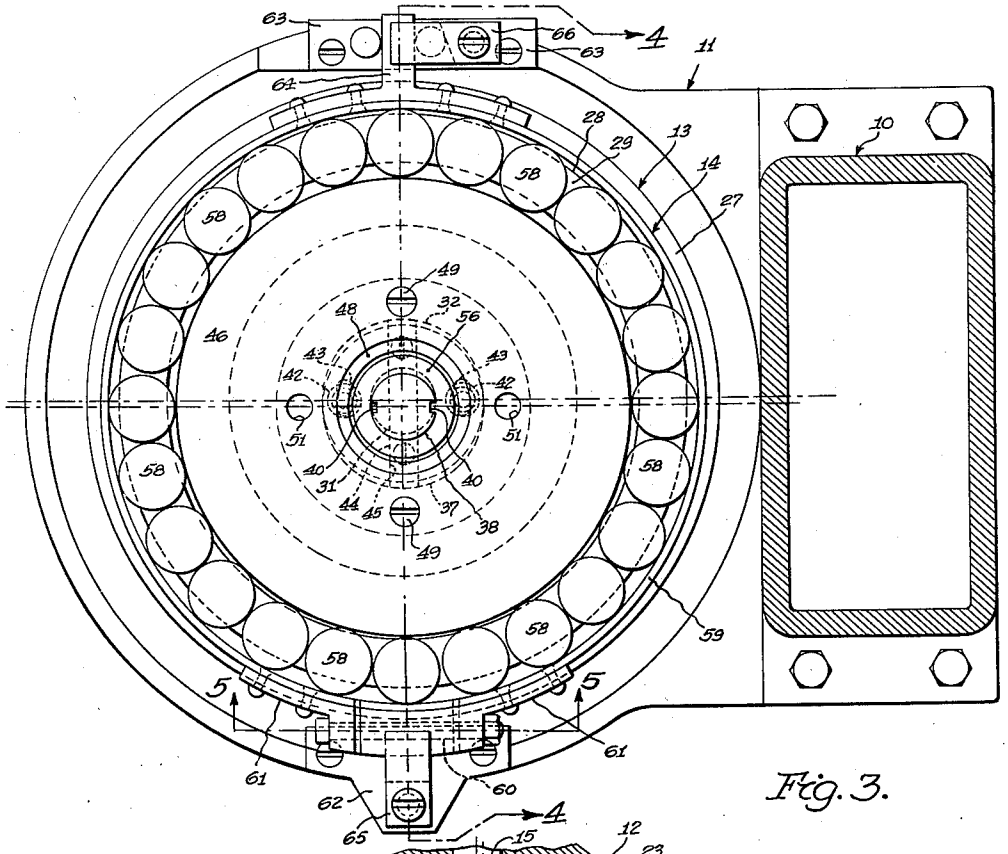


Fig. 3.

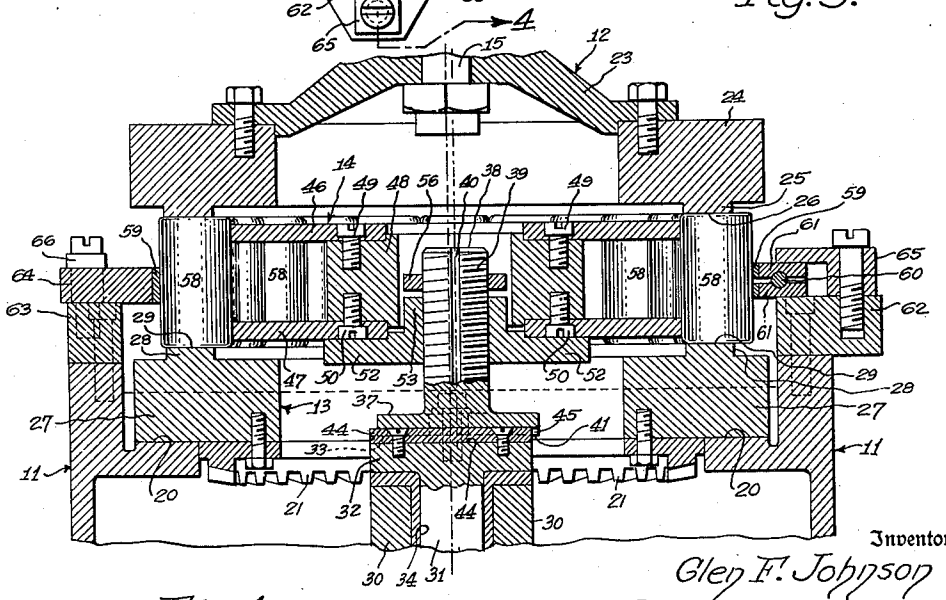


Fig. 4.

Inventor
Glen F. Johnson
By
Attorneys

Sept. 7, 1943. G. F. JOHNSON 2,328,809

LAPPING MACHINE

Filed May 23, 1941 3 Sheets-Sheet 3

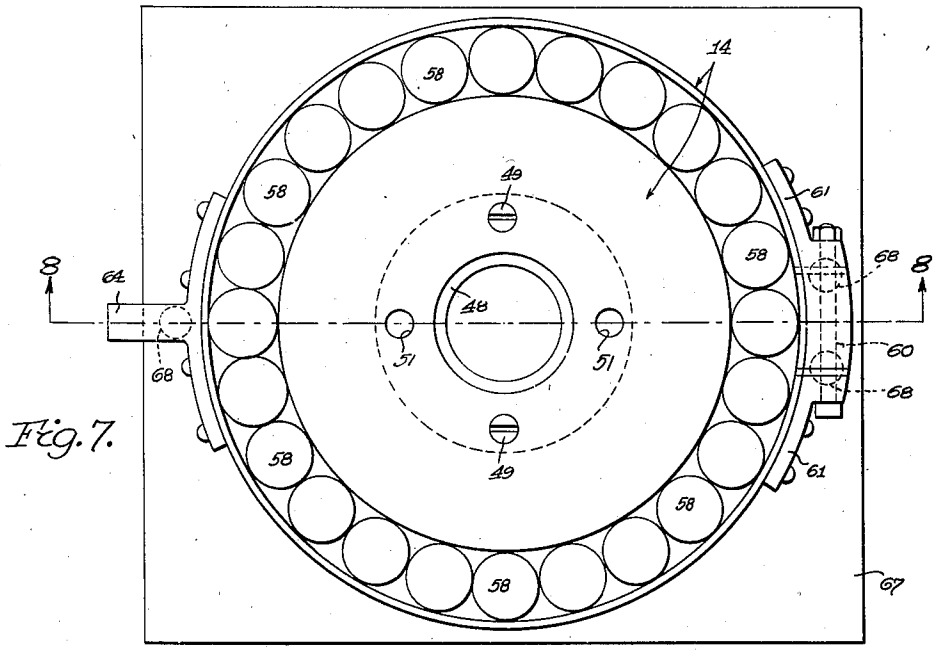


Fig. 7.

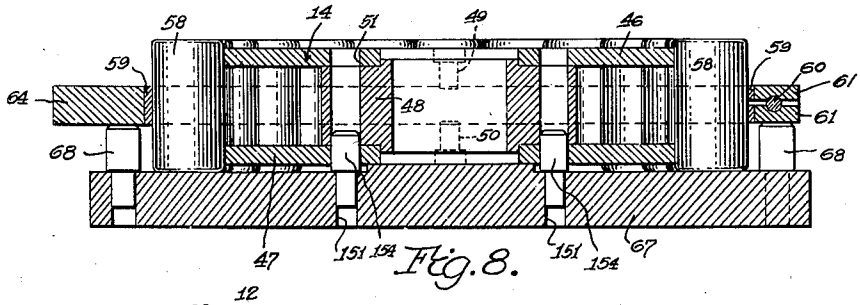


Fig. 8.

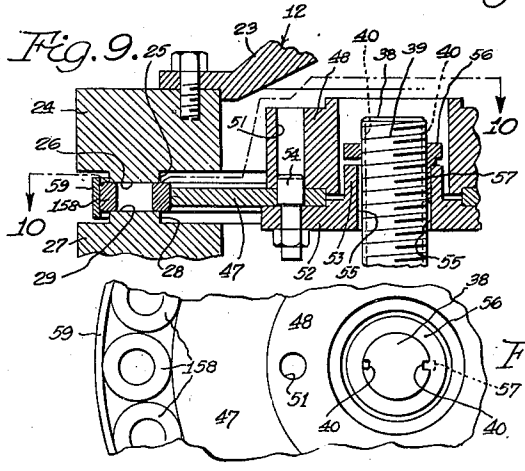


Fig. 9.

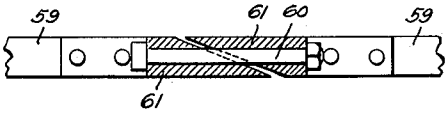


Fig. 5.

Fig. 10.

Inventor

Glen F. Johnson

By

Attorneys

Patented Sept. 7, 1943

2,328,809

UNITED STATES PATENT OFFICE

2,328,809

LAPPING MACHINE

Glen F. Johnson, Detroit, Mich., assignor to Bower Roller Bearing Company, Detroit, Mich., a corporation of Michigan

Application May 23, 1941, Serial No. 394,863

14 Claims. (Cl. 51—118)

This invention relates, in general, to lapping machines and, in particular, to the type which is capable of lapping the end surfaces of roller bearing members.

One of the objects of the present invention is to provide a new and improved lapping machine which produces a higher grade finish on the end surfaces of roller bearing members than heretofore.

Another object is to provide a new and improved lapping machine for the end surfaces of roller bearing members which is constructed more simply and compactly, operated more easily and efficiently and productive of better results than heretofore.

Another object is to improve a lapping machine having a pair of opposed lap surfaces between which work pieces are carried by a support whereby said surfaces, pieces and support are so movable with respect to each other that results heretofore unrealized may now be produced.

Another object is to provide a new and improved lapping machine which employs a pair of opposed lap devices and an intermediate work support and which devices and support may rotate relatively to each other with an eccentricity therebetween or with a concentricity therebetween, whichever is desired.

Another object is to provide a new and improved lapping machine for the end surfaces of roller bearing members which may be made readily adapted for sets of said members having different lengths.

Other objects and advantages of the invention will become readily apparent from a reference to the following specification taken in conjunction with the accompanying drawings of which there are three (3) sheets and wherein:

Figure 1 is a side view, partly in elevation and partly in section, of the lapping machine;

Figure 2 is a front elevational view of the machine;

Figures 3 and 6 are sections taken along the lines 3—3 and 6—6, respectively, in Figure 1;

Figures 4 and 5 are sections taken along the lines 4—4 and 5—5, respectively, in Figure 3;

Figure 7 is a plan view of part of the structure as it appears in an early stage of assembly thereof;

Figure 8 is a section taken along the lines 8—8 in Figure 7;

Figure 9 is a sectional view of part of the machine as it appears while performing a slightly modified function; and

Figure 10 is a section taken along the lines 10—10 in Figure 9.

The machine herein disclosed comprises a main supporting structure consisting of a pair of integrated, vertically spaced sections, generally indicated at 10 and 11, the upper section 10 serving as the supporting means for an upper lap device, generally indicated at 12, and the lower section 11 serving as the supporting means for a lower lap device, generally indicated at 13, there being a work carrying device, generally indicated at 14, arranged between said other two devices.

It is desired that one of the two lap devices be non-rotatable but rectilinearly movable and that the other of said devices be rotatable but non-rectilinearly movable. To illustrate means which can satisfy the first desire, section 10 carries a shaft 15 which is vertically reciprocable under the influence of means such as fluid pressure communicated in any well known and appropriate manner with opposite sides of a piston 16 fixed to the upper end of said shaft and reciprocably arranged within the cylinder 17 of a fluid pressure device, generally indicated at 18, of standard design and carried on said section, the lower end of said shaft being fixed to lap device 12 and there being provided in laterally spaced relation to said shaft a guide 19 which operatively interconnects said device and said section and assures unit 12—15—16 of pure reciprocatory motion. On the other hand, to illustrate means which can satisfy the second desire, section 11 is formed with a portion providing an annular, horizontal, planar surface 20 coaxially aligned with shaft 15 and adapted for supporting lap device 13 thereupon, said device carrying gear means 21 in driven connection with pinion means 22 carried by said section whereby said device may be rotated upon said surface about the coincident axes thereof.

Upper lap device 12, which is vertically reciprocable responsive to movement of piston 16 but non-rotatable, consists more or less specifically of an annular plate 23 centrally supported by shaft 15 and, in turn, supporting, at its periphery, a ring member 24 the under side of which is formed therearound with a downwardly protruding portion 25 providing an annular, horizontal, planar surface 26 which is concentric with the axis of said shaft and to which an abrasive or lapping material (not shown) is applied for performing the lapping function desired of said upper lap device.

Lower lap device 13, which is rotatable about

an axis aligned with the coincident axes of shaft 15 and surface 26 responsive to operation of pinion 22 but non-reciprocable, consists more or less specifically of a ring member 27, similar to ring member 24, the upper side of which is formed therearound with an upwardly protruding portion 28, similar to portion 25, providing an annular, horizontal, planar surface 29, similar to surface 26, which is concentric with the axis of said surface 26 and to which some of the aforementioned abrasive or lapping material is applied for performing the lapping function desired of said lower lap device. As stated before, the actual support for lap device 13 is surface 20, and it is to be noted that ring member 27 extends radially inwardly from said surface so that the under surface of this extension may be adapted for receiving and having secured thereto gear 21, the driven portion of unit 21—22. It will also be noted that the fit between the outer periphery of gear 21 and the inner periphery of the portion of support section 11 providing surface 20 is such as to assure co-alignment of surfaces 29 and 26.

Before discussing work carrying device 14, its assembly and its installation, attention is directed to the means provided in the machine whereby said device is carried and driven. Support section 11 is formed with a hollow boss 30 which is co-axially aligned with shaft 15 and surfaces 26 and 29 and provides a bearing support for a stub shaft 31. The upper end of shaft 31 has an outwardly flanged head 32 the upper surface 33 of which resides in a horizontal plane near or coincident with that containing surface 20, and a bearing 34 is preferably arranged between unit 31—32 and those portions of boss 30 receiving same. The lower end of shaft 31 carries gear means 35 operatively connected to pinion means 36 carried by support section 11 and is rotatable, therefore, about its axis by said gear means responsive to rotation of said pinion means. As a passing remark, it is to be noted that the drive between the elements of unit 35—36 is dissimilar to the drive between the elements of unit 21—22, the advantages derived from this feature being explained subsequently but its function being to establish a differential between the rotative speeds of lap device 13 and work carrying device 14 (the latter device, as will soon be understood, deriving its rotatability from the rotation of shaft 31 which is driven by said unit 35—36).

Head 32 of shaft 31 is adapted for supporting a similarly formed head 37 of another shaft 38 which is vertically upstanding and threaded along its length, as at 39, as well as being formed with one or more longitudinally extending keyways 40, said head 37 having a horizontal, planar surface 41 similar to and engaging surface 33 of said head 32. Units 31—32 and 38—37 are joined together for unitary rotation by means of a pair of diametrically spaced bolts 42 which pass through openings 43 provided therefor in head 37 of said unit 38—37 into threaded engagement with head 32 of said unit 31—32, said openings preferably being unidirectionally elongated so that the inter-joining of said units may produce either axial alignment of shafts 31 and 38 of said units, for concentric rotation of the one with respect to the other, or axial disalignment of said shafts, for eccentric rotation of the one with respect to the other, as desired. One of the two heads 32 or 37 preferably has fixed thereto a key 44 which extends in parallelism with openings 43 and is received in a complementary keyway 45 formed therefor in the other of said heads, this key tending to relieve bolts 42 of the torque established by rotation of unit 31—32 as well as to guide unit 38—37 during any adjustment which might selectively take place with respect to said unit 31—32. It is clear that, if permanent concentric rotation of units 31—32 and 38—37 is desired or if permanent eccentric rotation of said units is desired, said units may be made integral with one another with the axes of shafts 31 and 38 permanently aligned or dis-aligned and with the need for bolts 42, openings 43, key 44 and keyway 45 eliminated.

Work carrying device 14, by which it is proposed to carry the work movably between and in contact with lap surfaces 26 and 29, consists in part more or less specifically of an upper annular plate 46, a lower annular plate 47 and an annular spacer 48 interconnecting said plates at or near their inner peripheries, and with a definite vertical spacing therebetween, by means of at least a pair of arcuately spaced upper bolts 49 passing through said plate 46 into threaded engagement with said spacer and at least a pair of arcuately spaced lower bolts 50 passing through said plate 47 into threaded engagement with said spacer, this unit 46—47—48, as will soon be seen, being operable for arrangement concentrically about the axis of shaft 38 for movement therewith. The assembled unit 46—47—48 is so formed as to present at least a pair of vertical bores 51 which pass therethrough and reside between bolts 49 and 50, these bores having one function, as is to be seen in Figure 8, during the assembling of device 14 and another function, as is to be seen in Figure 1, during the employment of said device in the lapping operation, these functions being a matter for future discussion.

Unit 46—47—48 also includes a supporting base member having a lower flanged portion 52 and a central, upwardly extending boss portion 53, this base member being removably secured to said unit by means of dowels 54 secured to said flanged portion and extending upwardly into bores 51, and, in this assembled condition, said boss portion extends upwardly into the central portion of said unit in concentricity therewith. Member 52—53 is provided with a central, vertical, threaded bore therethrough in the side wall of which is formed a pair of diametrically spaced, vertically extending keyways 55. In assembly, unit 52—53, to which is attached unit 46—47—48 for movement therewith, is threadedly receivable on shaft 38, and on this shaft is freely receivable a ring member 56 from the under side of which extends a key 57 for simultaneous cooperation with one of the two keyways 55 and one of the two keyways 40. It can be seen, therefore, that key 57 serves as the driving connection between shaft 38 and base member 52—53, and also that the level of said member can be adjusted upon removing unit 56—57 from said shaft and turning said member in one or the other of its two directions, whereafter said level may be maintained by returning said unit to said shaft. It can also be seen that the provision of a single key, in the presence of a plurality of keyways in each of the two members receiving said key, provides for a more selective level adjustment of device 14 than if more keys were to be employed.

It is proposed to support work pieces, such as roller bearing members 58, between and in end-to-end relationship with lap surfaces 26 and 29

by means of work carrying device 14 so that said members may be moved not only about the axis of shaft 38 but also about their own axes. This movability of members 58 about the axis of shaft 38 is clearly compound with respect to lap surfaces 26 and 29, it being remembered that lap devices 12 and 13 are rotatable relatively one to the other and that work carrying device 14 and said lap device 13 are also rotatable relatively one to the other, these last two mentioned devices being also movable either with a concentricity or an eccentricity therebetween. However, the movability of members 58 about their own axes is brought about by employing an annular band member 59 which is non-rotatably supported substantially intermediate the ends of said members and held in frictional engagement therewith, said members being carried in plurality and axial parallelism within the annular space defined by the inner surface of said band and the outer peripheries of plates 46 and 47 and, therefore, in frictional engagement with said peripheries as well. Band member 59 is split so as to possess ends which may be joined together with variable spacings therebetween, whereby the inner diameter of said member may be varied to increase or decrease its friction-creating tendencies, this jointure being carried out by means of a fastener 60 which removably inter-locks a pair of lugs 61 fixedly carried one on one end of said member and the other on the other end of said member, and it is preferred that this band member split be on the diagonal, as shown in Figure 5, so as to minimize the break provided thereby in the inner running surface of said member.

It is clear from the foregoing that the non-rotatability of band member 59 and the rotatability of the plates 46 and 47 cooperate to move bearing members 58 simultaneously about their own axes and about the axis of shaft 38, and, while this is going on, whether said shaft and shaft 31 are rotating eccentrically or concentrically with respect to each other, which shafts, it is remembered, rotate relatively to each other, the end surfaces of said bearing members are being subjected to the lapping action of the relatively rotating, axially movable lap surfaces 26 and 29. Since this lapping action is more effective when shafts 31 and 38 rotate eccentrically with respect to each other than when said shafts rotate concentrically with respect to each other, the drawings show the machine set up for such eccentricity, but it is to be remembered that some jobs may be performed sufficiently satisfactorily with shaft concentricity and, for this reason, adjustability to attain either condition is deemed important and not to be overlooked.

Since it is desirable for the machine to be able to accommodate work having different lengths (heights), but not at one time, of course, and since it is practical for the band member to be supported substantially centrally between the ends of said work, supporting section 11 has a pair of substantially diametrically spaced shims 62 and 63 removably fixed thereto, and these shims are so dimensioned in height that, when lugs 61 (which interjoin the two ends of said band member) and another lug 64 (secured to said band member between said ends) are caused to rest thereupon, said band member will be held in such central position with respect to said work. Unit 59—61—64 is held in place on shims 62 and 63 non-rotatably by means of a pair of clamping members 65 and 66 removably secured to said shims and clampingly engaging lugs 61 and 64.

Figures 7 and 8 show the process followed in equipping unit 46—47—48 with work 58 and band unit 59—60—61—64 prior to the incorporation thereof in the machine proper. A plate 67 is employed and provided with means whereby unit 46—47—48 may be held in place thereon while the latter is being supplied with the work and band unit, such means comprising, for instance, a pair of openings 151 adapted for receiving dowels 154 which, in turn, register with bores 51 in said unit 46—47—48 to temporarily inter-lock said plate and said latter unit (it being remembered that these bores 51 later receive dowels 54 through which shaft 38 and device 14 are made unitarily rotatable). Plate 67 also carries means, such as dowels 68, which are arcuately spaced from each other similarly as lugs 61 and 64 of the band unit and extend to such a level that, when supporting said band unit, the latter will be positioned substantially centrally between the ends of the work. These band unit lugs 61 and 64 are positioned on dowels 68 while the ends of said unit are relatively unsecured, and the work pieces 58 are then placed between band 59 and plates 46 and 47 in such plurality as is desired. Thereafter, fastener 60 is tightened to produce the desired friction between the work and the inner wall of the band and between the work and the outer walls of the plates, whereupon device 14 is ready for being positioned in the machine as heretofore described.

A slightly modified use of the machine is shown in Figures 9 and 10, wherein the height (length) of the work, represented at 158, necessitates the employment of only one of the two plates 46 or 47 and either eliminates the need for shims 62 and 63 or calls, at most, for very thin ones (not shown). Otherwise, the machine operates as heretofore described.

Although the invention has been described with some detail, it is to be understood that such description is for the purpose of illustration only and is not to be taken as being definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

What I claim is:

1. In a lapping machine, means providing a pair of opposed lap surfaces, a pair of separably connected disks spaced from the lap surfaces and from one another supporting a plurality of work pieces in contact with and axial perpendicularity to said surfaces and in axial parallelism with an axis whereby the removal of one of said disks will facilitate supporting work pieces of reduced length, and a work piece encircling member cooperable with said separably connected disks for moving the pieces substantially simultaneously about their axes and said first-named axis.

2. In a lapping machine, means providing a pair of opposed lap surfaces rotatable relatively one to the other about an axis, a pair of separably connected disks spaced from said lap surfaces and from one another supporting a plurality of work pieces in contact with and axial perpendicularity to said surfaces as well as in axially spaced relation to said axis whereby the removal of one of said disks will facilitate supporting work pieces of reduced length, and means cooperable with said separably connected disks for moving the pieces substantially simul-

taneously about their axes and said first-named axis.

3. In a lapping maching, means providing a pair of opposed lap surfaces having a substantially common axis, a pair of separably connected disks spaced from said lap surfaces and from one another supporting a plurality of work pieces in contact with and axial perpendicularity to said surfaces and about said axis whereby the removal of one of said disks will facilitate supporting work pieces of reduced length, and means cooperable with said separably connected disks for moving the pieces substantially simultaneously about their axes and eccentrically about said first-named axis.

4. In a lapping machine, a pair of opposed lap surfaces between and in contact with which are carried axially spaced work pieces, the diameter of the work pieces being greater than the width of the lap surfaces, a pair of separably connected disks removed from said lap surfaces providing circular supporting walls adjacent opposite ends of and in contact with the work pieces for confining the same between the lap surfaces, and means cooperable with said separable disks for providing a three point contact with the work pieces whereby rocking movement thereof will be prevented.

5. In a lapping machine for finishing the ends of work pieces, a pair of oppositely spaced lap surface members having circular lapping zones of reduced width, a pair of separably connected disks removed from said lap surfaces and terminating adjacent said circular lapping zones providing an upper wall and a bottom wall frictionally cooperable with opposite ends of the work pieces, means encircling the work pieces intermediate their ends to retain the same against said upper and bottom walls and between said lapping zones, and means for rotating the separable disks for moving said work pieces in a hypocycloidal arc relative to the reduced lapping surfaces.

6. In a lapping machine for operating upon a series of work pieces, means providing a pair of spaced, parallel lap surfaces having circular lapping zones of reduced width engaging the ends of said work pieces, means spaced from the operative faces of the lap surfaces providing a pair of annular spaced walls engaging the work pieces adjacent the ends thereof, a flexible band encircling the work pieces for frictionally engaging the same intermediate their ends, and means for rotating said walls relative to the lap surfaces and flexible band.

7. In a lapping machine for finishing work pieces, means providing a pair of spaced, parallel lap surfaces having circular work engaging surfaces of reduced widths, said work pieces being arranged in seriatim with the ends diametrically positioned relative to the circular work engaging surfaces, means spaced from said lap surfaces providing a pair of relatively rotatable, concentrically arranged walls positioned adjacent the inner and outer peripheral portions of said circular work engaging surfaces for receiving the work pieces therebetween and cooperable for exerting a three point frictional force thereupon, one of said concentric wall means including separated disk members, and means associated with the other of said concentric walls for varying said force.

8. In a lapping machine, means providing a pair of opposed lap surfaces having a substantially common axis and between and in contact with which surfaces are carried axially spaced work pieces, means spaced from the operative faces of the lap surfaces providing walls on opposite sides of and in frictional contact with the pieces for confining the latter therebetween, one of said walls comprising separably connected disk members to facilitate supporting work pieces of various lengths, means operable for rotating said separably connected walls eccentrically with respect to said axis, and means for frictionally urging the opposite wall into frictional engagement with the work pieces intermediate the ends thereof.

9. In a lapping machine, means providing a pair of opposed, relatively rotatable lap surfaces having circular work engaging portions of reduced width, supporting means for work to be lapped by said surfaces and including a pair of separably connected disks adapted to engage the work pieces adjacent their ends, a work encircling band surrounding said work and engaging the intermediate portion thereof, said disks and band being operable for establishing frictional contact with the work, and means for rotating said disks relative to said band and to said circular work lapping surfaces.

10. In a lapping machine, means providing a pair of opposed lap surfaces having circular lapping faces of reduced width rotatable relatively one to the other about an axis, supporting means for work to be lapped by said surfaces to position the work with the reduced lapping faces extending diametrically thereof and including a pair of concentrically arranged members providing a space therebetween and in spaced relation from said surfaces for receiving the work, one of said members including separably connected disks engaging the work adjacent its ends, the other member comprising a band encircling the work and engaging the same between its ends, said members being operable for establishing frictional contact with the work at three points of contact, means for rotating said members relatively one to the other and to said surfaces, and means operable for causing said relative rotation of said members to be eccentric with respect to said axis.

11. In a lapping machine having a pair of relatively rotatable lap surfaces having circular lapping areas of reduced width, a device for supporting work between the surfaces for being lapped thereby and comprising a pair of separably connected disk members engaging the work adjacent their ends, means defining a second wall spaced laterally from said first-named wall comprising a flexible band encircling and engaging the work pieces intermediate their lengths, said walls cooperating to provide a space therebetween for receiving the work and engaging the same in three point contact, one of said walls being movable toward the other of said walls to establish a frictional contact between the work and said walls, and means operable for rotating said disk members relatively to the flexible band and to the lapping surfaces.

12. In a lapping machine having a pair of lap surfaces having lapping areas of reduced width relatively rotatable one to the other about an axis, a device for supporting work between the surfaces for being lapped thereby and comprising a pair of separably connected spaced disks defining a wall spaced intermediate the surfaces and out of engagement therewith, means defining a second wall spaced laterally of said first-named wall and comprising a flexible band en-

circling said work pieces, said walls cooperating to provide a space therebetween for receiving work of various lengths therewithin, one of said walls being movable toward the other of said walls to establish a frictional contact between the work and said walls, means operable for rotating said walls relatively one to the other and to the surfaces, and means causing said relative rotation of said walls to be eccentric with respect to said axis, said last named means comprising a rectilinearly movable member supporting said separably connected work supporting disks.

13. In a lapping machine, means providing a pair of lap surfaces rotatable relatively one to the other about an axis having lapping areas of reduced width, a pair of spaced separably connected disks forming a work support having an axis of rotation aligned with said first-named axis and movable thereabout, said support being removed from contactual engagement with said lap surfaces, a flexible band encircling the work pieces operable for supporting work pieces between and in contact with said surfaces for being lapped thereby, and a rectilinearly movable supporting shaft for the separably connected disks for selectively rotating the latter either eccentrically or concentrically with respect to said aligned axes.

14. In a lapping machine, a pair of lapping disks providing a pair of opposed surfaces movable relatively one to the other about and along an axis, a rotary shaft extending through one of said lapping disks, a rectilinearly movable member mounted on said shaft, a pair of separably connected disks removably mounted on the rectilinearly movable member rotatable about an axis positioned radially inwardly of said surfaces, one of said disks being removable for accommodating work of reduced size, a work encircling band adapted to position work between said lap surfaces, and means operatively interconnecting said pair of separably connected disks and said rectilinearly movable member whereby said separably connected disks may be moved along said axis relatively to said surfaces.

GLEN F. JOHNSON.