Nov. 21, 1950 E. DICKINSON 2,530,424

LAPPING MACHINE

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FIG. 1.

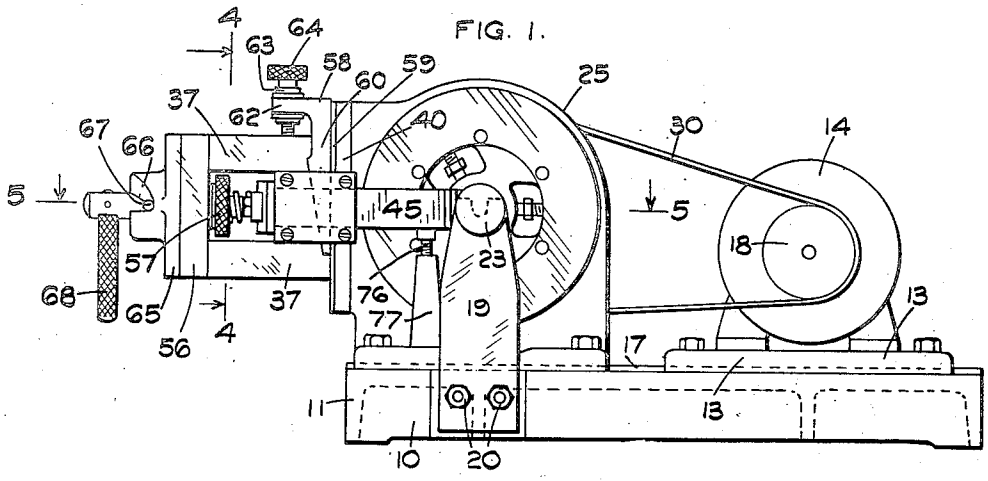


FIG. 2.

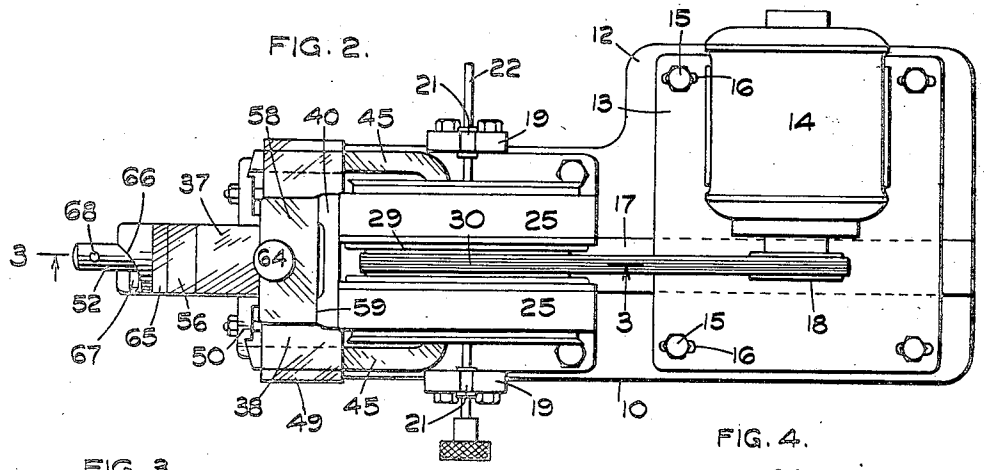


FIG. 3.

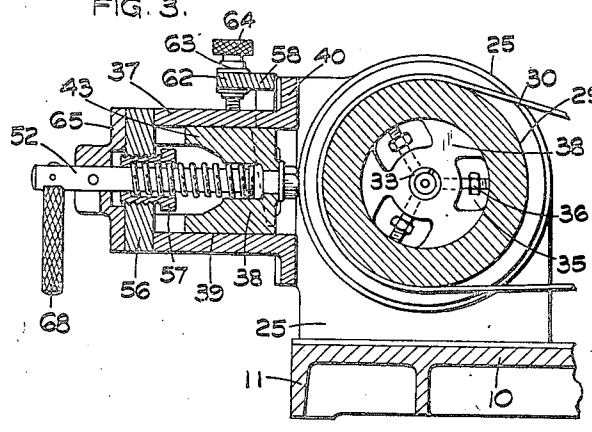
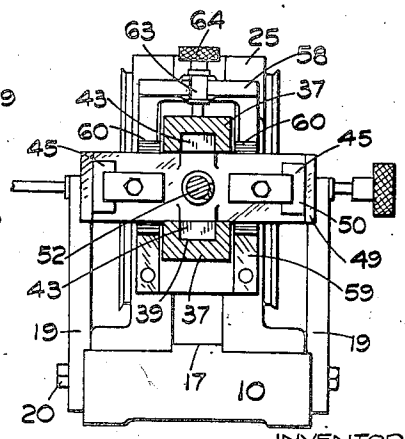


FIG. 4.



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LAPPING MACHINE

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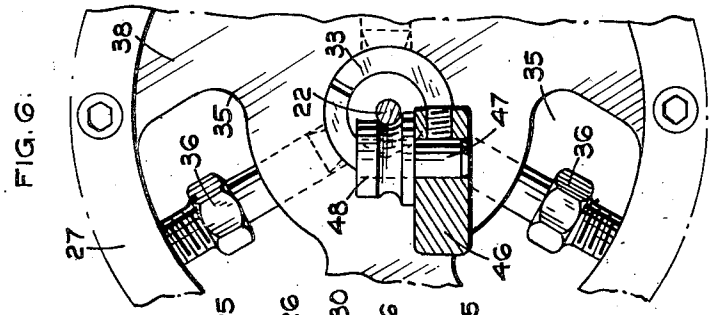


FIG. 6.

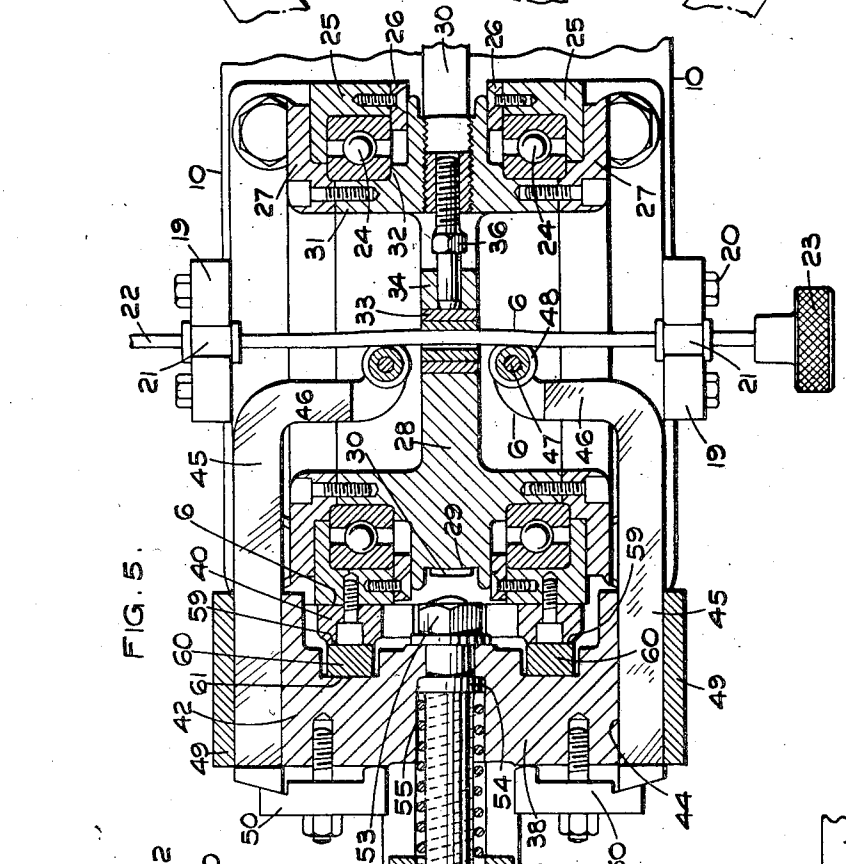


FIG. 5.

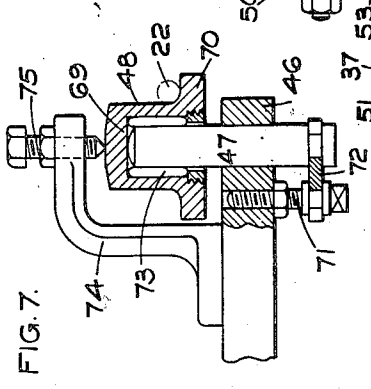


FIG. 7.

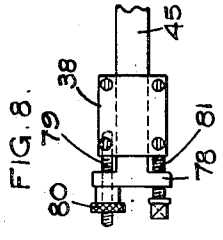


FIG. 8.

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FIG. 9.

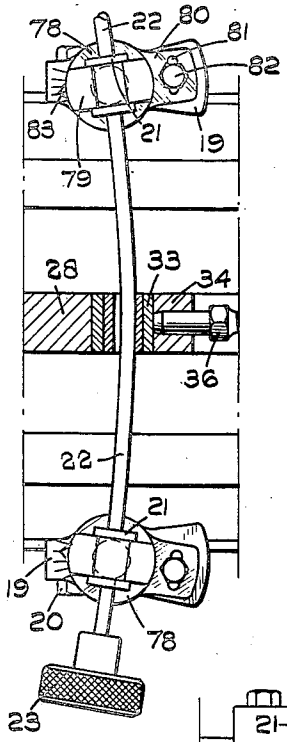
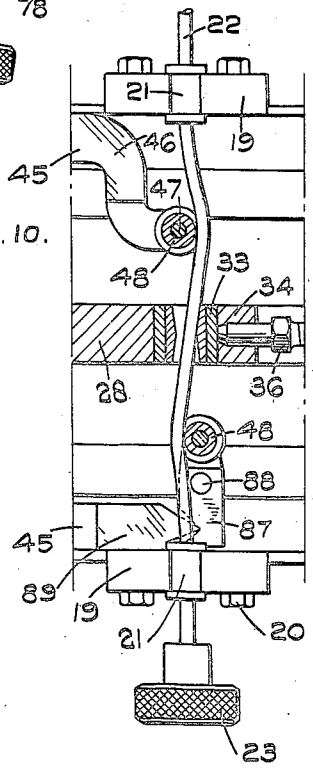


FIG. 10.



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Patented Nov. 21, 1950

2,530,424

UNITED STATES PATENT OFFICE

2,530,424

LAPPING MACHINE

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Application July 31, 1947, Serial No. 765,024
In Great Britain December 21, 1945

8 Claims. (Cl. 51—67)

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This invention relates to lapping machines of the kind in which a reciprocable lapping rod or tool is provided to operate through a hole in the rotating work. When in use the lapping tool is provided with abrasive material.

In lapping machines hitherto proposed for lapping openings of venturi shape as in wire drawing dies the lapping wire or tool is given the required bowed form by placing supports through which it is guided out of line with the opening in the work, the resultant thrust of the work producing the required bowed form. In such an arrangement the shape of the bowed form depends upon the lateral pressure between tool and work and thus the shape is necessarily effected if, to alter the rate of removal of metal from the work, the lateral pressure is eased or increased somewhat.

In another arrangement in which the degree of bowing need not depend entirely upon the lateral thrust of the work, supports for the lapping tool arranged on either side of the work serve to clamp portions of the lapping tool so that it may take up a bowed form even in the absence of the work; the supports however are moved bodily with the lapping tool so that in the course of reciprocation of tool and supports engagement of the work by the lapping tool necessarily modifies the shape of the bowed form.

One object of the present invention is to provide a lapping machine having improved means for giving the lapping tool a bowed form in which modification of the bowing by the lateral thrust of the work is eliminated or reduced.

Another object of the present invention is to provide a lapping machine for lapping the walls of openings which are or which are required to be of barrel shape, or for lapping the walls of other openings to which similar treatment is required to be applied although not necessarily continued to the stage at which the opening becomes barrel shaped. For instance a primary object of the invention is to provide a machine for finishing the surfaces of cylindrical holes particularly in very hard material more accurately than hitherto.

The essential feature of the present invention is that the bending means acting upon the lapping tool to bend it into bowed form acts independently of the lateral thrust of the work upon the lapping tool and the bending means are stationary relative to the work in the direction of reciprocation of the lapping tool so that the shape of the bowed portion is not modified in the reciprocation of the lapping tool.

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The invention is illustrated in the accompanying drawings, wherein:

Figure 1 is a view in side elevation.

Figure 2 is a view in plan.

Figure 3 is a section on the line 3—3 of Figure 2.

Figure 4 is a section on the line 4—4 of Figure 1.

Figure 5 is a section on the line 5—5 of Figure 1.

Figure 6 is a section on the line 6—6 of Figure 5.

Figure 7 is a view in end elevation showing another method of mounting the rollers in an adjustable manner, and

Figure 8 is a view in side elevation illustrating a modification.

Figures 9 and 10 are plan views showing alternative methods of imparting the necessary bowing to the lapping tool. The bowing has been greatly exaggerated for the sake of clarity.

Figures 5, 6, 7, 9 and 10 are drawn to a larger scale than Figures 1 to 4 and 8.

In the construction illustrated the machine comprises a base plate 10, which may be formed as a casting and which may have a downwardly-directed peripheral flange 11 and a number of downwardly-projecting ribs on its underside extending from and connecting the peripheral lips at opposite sides.

At one end the base plate is provided with a portion 12 which is wider than the remainder of the base plate, and adjustably mounted on this portion is a supporting plate 13 upon which is mounted an electric motor or other power unit 14. The plate 13 supporting the power unit may be attached to the base plate by means of studs 15 which pass through slots 16 in the supporting plate, the slots being parallel to the length of the base plate so that the position of the power unit can be adjusted on the base plate.

The base plate 10 is further provided with an upwardly-projecting rib 17 arranged longitudinally, and the underside of the supporting plate for the power unit is provided with a channel which engages over this rib.

The motor or power unit has a driving shaft which projects from one end and extends over the said rib, and on this driving shaft is mounted a driving pulley 18. If desired reducing gearing may be interposed between the driving pulley and the driving shaft of the power unit.

Mounted at opposite sides of the narrower part of the base plate are two brackets 19, one at

each side. These brackets are bolted at 20 to the sides of the base plate, and they extend upwardly. At the top they are provided with bushes 21 which form supporting guides for the reciprocating lapping tool 22 the internal bearing paces of the bushes providing support for the lapping tool in a direction substantially radial with respect to the wall portion of the opening in the work which as will appear from the subsequent description the lapping tool will engage. This tool may take the form of a cylindrical rod, and if it is to be hand-operated, at one end on the outer side of one of the supporting bushes it is provided with a knob 23 by which it may be operated.

Instead of operating the lapping tool by hand, it may be mechanically operated, in which case it is reciprocated in the two bushes, and it may be given a periodical turning movement on its own axis.

Mounted concentrically with the bushes which support the lapping tool we provide on the base plate, one on either side of the longitudinal rib thereon, two bearing housings 25. Each of these bearing housings is adapted to receive a ball or roller bearing 24, and these bearings may be retained in position in the housings by inner and outer plates 26, 27 secured to opposite sides of the housings, these plates engaging partially over the ends of the bearings.

The work holder takes the form of a pulley 28 mounted in these bearings, the pulley having a portion between the bearings, which pulley may have a grooved periphery 29 upon which operates a driving belt 30 engaging the pulley 18 driven by the power unit.

The pulley 28 forming the work holder is provided with flanges 31 on either side of its central belt-engaging portion, and these flanges engage the inner members of the ball or roller bearings 24 and are supported thereby. The flanges 31 are shouldered at 32 so that the bearings are engaged each at one end, as well as at the inner periphery.

The central part 34 of the pulley forming the work holder is provided with a cylindrical opening in which is mounted a bush 33 which is split longitudinally and forms a work-gripping device. This central part 34 of the pulley forming the work holder is provided with a plurality of openings 35 spaced around the centre, and in two or more of these openings are situated radial set screws 36 adapted to act upon the split bush 33 for gripping the work which is mounted within the bush.

The bearing housings 25 at the end remote from the power unit are provided with flat surfaces 6 disposed at right angles to the top of the base plate, and secured to these surfaces by suitable means are two guide members 37 extending horizontally and adapted to form a fixed guide for a sliding block 38.

These guide members 37 have portions 39 of channel form in which portions of the sliding block 38 engage. The guide members are provided with flanges 40 which are bolted to the sides of the bearing housings, and their channel-section guide portions extend horizontally one above the other in spaced relationship, the open sides of the channels being directed towards each other.

The sliding block 38 is provided with a portion 42 which extends horizontally between the edges of the channel-section guides and is further provided with longitudinal ribs 43 on the centre line

above and below which engage in the channels of the guide members.

The main part 42 of the sliding block extends horizontally and transversely between the guide members, and the outer ends of these horizontally and transversely extending portions are formed as channels 44 in which are secured a pair of arms 45 extending laterally towards the lapping tool and having their end portions 46 cranked inwardly and carrying pins 47 upon which are mounted flanged rollers 48 which engage one side of the lapping tool on either side of the split bush forming the work holder, the flange of each roller including an axially directed tool carrying face portion.

Each roller 48 and associated bracket 19 provided with a bush 21 forming a journal bearing for the lapping tool combined to define a guide path for the lapping tool. This guide path is defined both in the horizontal and the vertical plane since the bush encircles the lapping tool at one end and since at the other end of the guide path the roller is provided with a flange having an axially directed tool carrying face portion which locates the lapping tool in the vertical plane whilst location in the horizontal plane is achieved by the radially directed circumferential face of the roller. As shown in Figure 6 the axial and radial locating faces of the roller may, in fact, merge into one another by virtue of the peripheral groove of part circular cross section provided in the circumferential face of the roller and in which the lapping tool 22 is seated.

In the modification shown in Figure 7, each of the rollers 48 is closed at the end 69 and is supported on the pin 47 mounted in the arm 46. At its lower end each roller 48 is provided with a flange 70 engaging beneath the lapping tool, and in order to make provision for different diameters of lapping tool, the pin 47 may be adjusted vertically by means of a screw 71 having a flange 72 engaging in a groove in the pin 47. The screw 71 screws into the arm 46.

The roller 48 may be mounted on a bush or a roller or ball bearing 73. In order to prevent the roller 48 from moving upwardly and leaving the pin 47, we may provide a bracket 74 on the arm 46 having a portion extending above the roller 48 and an adjustable screw 75 for engaging the top of the roller.

The arms 45 carrying these flanged pressure rollers are located in channels at the outer ends of the sliding block 38, and are fixed therein by separate clamping plates 49, 50, respectively engaging the sides and ends of the said arms.

The arms 45 may receive additional support at the position where the arm 45 joins the arm 46 and such support may be received from an adjustable screw 76 screwing into a pillar 77, these pillars being mounted upon the bases of the bearing housings 25.

Further, as shown in Figure 8, one or both of the arms 45 may be adjustable in an endwise direction, and for this purpose the end of the arm remote from the roller 48 may be acted upon by an end piece such as a plate 78 mounted on a stud 79 screwing into the block 38, the plate 78 being adjustable towards and away from the block 38 by a nut 80 on the stud 79 and by a screw 81 screwing into the plate 78 and having its end engaging the end of the block 38.

The sliding block 38 is acted upon by a coiled compression spring 51, and this spring is placed upon a central pin 52 extending through the

sliding block and secured to it by a nut 53 engaging a washer at one side of the sliding block, the pin having a flange 54 engaging in the end of a recess 55 in the opposite side of the sliding block.

The ends of the two guide members 37 in which the sliding block operates are connected by a cross-plate 56 in which is a threaded hole, into which screws an abutment formed as a cup-shaped box 57 for one end of the compression spring 51. This box can be adjusted by turning it on its own axis so as to vary the pressure of the spring. One end of the spring is housed in this box and engages the end of the box, while the opposite end of the spring engages the flange 54 on the pin 52 which is attached to the sliding block, the arrangement being such that the spring presses the sliding block towards the lapping tool and causes the flanged rollers carried by the two arms to press against the side of the lapping tool which is remote from the power unit.

It will be apparent that the lapping tool is thus bent into bowed formation by the pressure of the rollers, and that the flanges on the rollers provide a tool supporting face which resists thrust exerted upon the lapping tool in a direction tangential to the wall portion of the opening in the work engaged by the lapping tool.

As seen more especially in Figure 5 it is preferred to place the rollers close to the work so that the flanges of the rollers give such tangential support to the lapping tool close to the ends of the portion of the tool within the work.

This spring pressure acting upon the sliding block operates against a wedge device constituting an adjustable stop which is formed as a U-shaped member 58, the limbs of which slide vertically against suitable facings 59 on the flanges 40 of the guide members 37. The opposite sides of the vertical limbs 60 of the adjustable stop 58 are formed as inclines and engage correspondingly inclined surfaces 61 provided on the sliding block 38.

At the top the two limbs of the adjustable stop are integrally connected and are provided with a horizontally-extending flange 62 in which is mounted a nut 63 having flanges engaging opposite sides of the flange 62 of the adjustable stop. This nut engages a vertical screw 64 carried by the upper guide member 37, and the arrangement is such that when the nut is turned the adjustable stop member 58 is adjusted either upwardly or downwardly so as to effect an alteration of the extent to which the spring pressure can bend the lapping tool.

In order that finished work may be taken out and fresh work inserted, means are provided for moving the arms 45 carrying the pressure rollers in an endwise direction to bring them away from the lapping tool so that the lapping tool can be withdrawn from the work and the work removed and a fresh piece of work inserted.

To provide for this movement of the pressure rollers and the arms carrying them, I mount upon the connecting plate 56 secured to the ends of the two guide members a cam plate 65 having a face cam 66 at its end adapted to be engaged by a cross peg 67 extending through the pin 52, the arrangement being such that when the pin is turned on its own axis it is moved in an endwise direction through a suitable distance and retained in its new position. Movement of the pin in this way will move the sliding block so as to bring the pressure rollers away from the side of the lapping tool. The pin is provided with a lever handle 68 by which it may be turned.

In the alternative construction illustrated in Figure 9 the bowing of the lapping tool 22 is obtained by mounting the supports 21 for said lapping tool so that their axes are not parallel but form an obtuse angle. Each support 21 is mounted on a circular bed 78 said bed being itself pivotally mounted on the top of the bracket 19 said bracket being suitably modified for this purpose. The bed 78 has a pair of upstanding arms 79 which are adapted to partially embrace and to secure the supports 21 and a lug 80 extends sideways from said bed and this lug 80 carries an arcuate slot 81. A bolt 82 passes through this slot 81 and engages in a tapped hole formed in the bracket 19 so that the bed 78 and the support 21 may be clamped in a plurality of different positions. The bed 78 is provided with a pointer 83 adapted to operate over a suitable scale marked on the bracket 19 to indicate the degree of bowing of the lapping tool for a given setting of the bed.

In Figure 10 is illustrated a still further method of obtaining the bowing of the lapping tool wherein pressure is applied from opposite directions and on opposite sides of the tool. The supports 21 for the lapping tool 22 are rigidly mounted on the bracket 19 and two pressure rollers 48 are mounted one on each side of the work and these rollers 48 act on the tool 22 from opposite directions the one being carried by arms 45 and 46 and operated in the manner described above. The other roller 48 is carried by a lever 87, said lever being mounted at 88 for pivotal movement about a vertical axis and the end of said lever having a V shaped recess cut therein whereby it may be engaged by a head 89 said head being attached to one of the arms 45 whereby equal pressure, from opposite directions, may be exerted on the tool 22 by the rollers 48.

What I claim then is:

1. A lapping machine comprising a holder for the work, a reciprocable lapping tool adapted to extend through an opening in the work, means for rotating the work holder and the tool relatively with the tool engaging successively circumferentially spaced wall portions of the opening in the work, a pair of arms extending laterally towards the lapping tool, a supporting structure for said arms, said supporting structure comprising a fixed guide arranged substantially at right angles to the lapping tool, a slidable block mounted in said guide, said arms being carried by said block, a spring acting on said block and pressing it towards the lapping tool, a wedge device operating between a fixed surface of said block and adapted to limit the movement of the block under the influence of the spring, said arms being spaced apart one on each side of the work holder and having cranked end portions carrying rollers adapted to apply to the lapping tool a lateral thrust, radial supporting elements for the tool positioned on each side of the work, said elements including tool supporting abutment portions facing in a direction substantially radial with respect to the wall portion of the opening which the tool is adapted to engage and counter to the direction of said lateral thrust of the rollers upon the tool, said rollers engaging the tool to apply said lateral thrust at positions intermediate said radial supporting elements and the work.

2. A lapping machine comprising a holder for the work, a reciprocable lapping tool adapted to

extend through an opening in the work, means for rotating the work holder and the tool relatively with the tool engaging successively circumferentially spaced wall portions of the opening in the work, a pair of arms extending laterally towards the lapping tool, a supporting structure for said arms, said supporting structure comprising a fixed guide arranged substantially at right angles to the lapping tool, a slidable block mounted in said guide, said arms being carried by said block, a pin mounted on said block and arranged parallel to the guide, a plate secured to the supporting structure at the end of the guide remote from the tool, said plate having an opening through which the pin extends, a flange on said pin, a spring disposed on said pin and acting between said flange and abutment means secured to said plate, said spring pressing said pin and block towards the lapping tool, a cross peg on the portion of the pin projecting from said plate, a cam plate carried by said plate and co-operating with said cross peg in the rotation of the pin in one direction to impart endwise movement to the pin and block away from the lapping tool, a wedge device operating between a fixed surface and said block and adapted to limit the movement of the block under the influence of the spring, said arms being spaced apart one on each side of the work holder and having cranked end portions carrying rollers adapted to apply to the lapping tool a lateral thrust, radial supporting elements for the tool positioned on each side of the work, said elements including tool supporting abutment portions facing in a direction substantially radial with respect to the wall portion of the opening which the tool is adapted to engage and counter to the direction of said lateral thrust of the rollers upon the tool, said rollers engaging the tool to apply said lateral thrust at positions intermediate said radial supporting elements and the work.

3. In a lapping machine of the kind specified, a rotary workholder, and guide structures positioned on each side of the workholder, each of said guide structures comprising a fixed journal bearing for a lapping tool, and a roller positioned intermediate said bearing and the workholder and supported adjustably in relation to said bearing in a direction transverse to the axis of said bearing, said roller being provided with means for preventing movement of a lapping tool across its circumferential face.

4. In a lapping machine of the kind specified, a rotary workholder, and guide structures positioned on each side of the workholder, each of said guide structures comprising a fixed journal bearing for a lapping tool, and a roller positioned intermediate said bearing and the workholder and supported adjustably in relation to said bearing in a direction transverse to the axis of said bearing and the axis of the roller, said roller being provided with means for preventing movement of a lapping tool across its circumferential face.

5. In a lapping machine of the kind specified, a rotary workholder, and guide structures positioned on each side of the workholder, each of said guide structures comprising a fixed journal bearing for a lapping tool, and a roller positioned intermediate said bearing and the workholder and closely adjacent to the latter, said roller being supported adjustably in relation to said bearing in a direction transverse to the axis of said bearing, and said roller being provided with means for preventing movement of a lapping tool across its circumferential face.

6. In a lapping machine of the kind specified, a rotary workholder and guide structures positioned on each side of the workholder, each of said guide structures comprising a fixed journal bearing for a lapping tool and a roller positioned intermediate said bearing and the workholder and supported on an arm having a roller supporting inner end portion cranked inwardly towards the side face of the workholder, said roller being supported adjustably in relation to said bearing in a direction transverse to the axis of said bearing and said roller being provided with means for preventing movement of a lapping tool across its circumferential face.

7. In a lapping machine of the kind specified, a rotary workholder, and guide structures positioned on each side of the workholder, each of said guide structures comprising a fixed journal bearing for a lapping tool, and a roller positioned intermediate said bearing and the workholder and supported adjustably in relation to said bearing in a direction transverse to the axis of said bearing and the axis of the roller, said roller being provided with a lapping tool supporting flange co-planar with the axis of the workholder.

8. In a lapping machine of the kind specified, a rotary workholder, and guide structures positioned on each side of the workholder, each of said guide structures comprising a fixed journal bearing for a lapping tool, and a roller positioned intermediate said bearing and the workholder and supported adjustably in relation to said bearing in a direction transverse to the axis of said bearing and the axis of the roller, said roller being provided with a groove in its circumferential face, said groove being of part-circular cross-sectional shape, and co-planar with the axis of the workholder.

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